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THE

JOURNAL OF SCIENCE,

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ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

Vol. IV. (THIRD SERIES)
No. XCIX.

MARCH
1882.

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THE

JOURNAL OF SCIENCE.

MARCH, 1882.

I. THOUGHTS ON CHEMICAL AFFINITY.

By CHARLES MORRIS.

IN my paper on the Principles of Magnetism, published in the "Journal of Science" for January and February, 1882, certain theoretical views were advanced which seem susceptible of a wider application than was there given them. In the present paper I propose to apply them to the phenomena of Chemical Affinity.

The whole science of Chemistry consists in the investigation of the attributes and combining properties of the molecules of matter. It begins with an investigation of the differences and relationships of the bases of the several elements—the so-called chemical atoms. It follows with a like investigation of the various compounds of these elements, and of the peculiarities of attraction which they display. Their physical properties, their electrical behaviour, &c., are included in the above summary.

But when we come to ask, What are the properties of elementary and compound substances? we are apt to receive a much too diffuse answer. Their colours, tastes, shapes, and their physical effects upon the human system, are given as distinguishing properties. These characteristics are, of course, important as aids to the recognition of substances, yet they express only their physiological effects; their action upon light, and through it upon our senses; or the results of their direct contact with the body.

But if we consider only the immediate relations of the elements with each other, these external characteristics, which apply to them principally as masses, disappear.

There remain only their affinities, their specific gravities, and their thermal and electrical relations. It is to their affinities we wish here to particularly refer. The minute particles of elementary matter attract each other with a vigour which differs with every change of substance, being powerful in some cases, and weak or non-existent in others. And this attraction is more powerful between elementary atoms than between compound molecules. If Chemistry be rigidly separated from other sciences, the above phrases almost completely embrace it.

But what are the true characteristics of the attractions which thus tend to combine chemical atoms and molecules into more complex molecules? Or we might first ask, What are the characteristics of attraction? It has, as we know, one general form, that of gravitation, which affects all matter alike, without discrimination. It has, also, one special form, that of magnetism, which affects all compounds of matter, but which specially discriminates. In its general form of gravitation I have argued in a preceding paper that the attractions of matter are balanced by their repulsions, but that the attractive matter has everywhere gathered into globes and systems, so that repulsive vigour, in its general aspects, now only exists between widely separated masses of matter. In its special form of magnetism the attractions are visibly balanced by the repulsions, these conditions occurring together in every mass of matter. Beyond these two modes of attraction there is no positive evidence that any other exists; for electric attraction may possibly be a special display of magnetic energy, while physical cohesion and adhesion resemble gravity in their characteristics. There remains but chemical attraction, and we may reasonably ask Is this a special mode of attraction, or is it a manifestation of gravitative or of magnetic energy? It cannot be a result of gravity, since it discriminates in its action. It therefore must be magnetic, or else a special mode of attraction.

As to which of these explanations should be adopted we have a useful rule of guidance. If it were impossible to explain chemism by any known mode of energy, then there would be some warrant for ascribing it to our unknown mode. But if it can be shown to be explainable by a known mode, this obviates the necessity of seeking any unknown mode; since it is undeniable that whatever tends to simplify and reduce the seeming complexity of natural principles is in the true path of correct discovery. Let us try, then, if we can apply the laws of magnetic energy to the phenomena of chemical affinity.

The ordinary display of magnetism is an influence emanating from molecules which are separated by considerable intervals, and whose magnetic effect upon each other is, therefore, much decreased. But in chemical action the spaces separating the molecules are greatly reduced. The heat energy which kept them asunder is yielded outwardly, and they come into intimate union. They are then in a position to develop each other's magnetism. In the former case they resembled two magnets so far separated as only slightly to affect each other. In the latter case they resemble two magnets which are made to touch each other.

But magnets may touch in different modes, and thus produce various combinations. If brought together end to end, they attract if their adjacent poles are unlike, and thus compose a single long magnet. There is no doubling of energy in this double magnet. It attracts no more strongly than did each of its constituents. If the magnets are brought together side by side, with unlike poles in conjunction, they will also attract, but the magnetism of each will mask that of the other, and thus there will be no external display of magnetic energy. If brought together, in either of the above positions, with like poles adjacent, they will mutually repel.

If, instead of two, three or more magnets be employed, their possible modes of combination will increase in variety. The effective energy of a strong magnet may be decreased by astatic union with weaker magnets. Also the poles of a strong magnet might attract several weaker magnets, whose free poles, being of the same name, would mutually repel.

If, now, chemical affinity really arise from the attractive relations of molecular magnets, brought very close together, it should display peculiarities like those seen in the combinations of mass magnets. But it might also display characteristics not usually seen in the mutual action of mass magnets. The facility of rotation of the molecules would tend to make them usually assume the strongest magnetic relation, that of astatic union: they might, if in considerable number, unite in all the various modes in which a collection of magnets would come together, but when only two molecules were concerned their combination would most probably be astatic.

This idea is very significant if we apply it to one of the primary chemical actions. It is now generally believed that the chemical atoms never, or only in exceptional cases, exist singly, but that they are ordinarily combined in pairs. And

it is also found that when single, as when just released from combination with some other element, their chemical vigour is far stronger than after they have had time to combine among themselves, and form atomic pairs. Such a result would necessarily follow if their attractions were magnetic. In the free, or nascent, state their magnetic attraction must be far more vigorous than after they have formed astatic pairs with each other, and thus have become magnetically inert. In a case like that of ozone, where three chemical atoms of equal strength are conjoined, we would have a weak magnetic system, since each magnet must disturb the attraction of the other two. One of these oxygen atoms might thus readily yield to outer attractions, and the two remaining enter into a more vigorous union. But four atoms, as in the molecules of phosphorus and arsenic, might naturally conjoin in a square or circle, each being astatic to its two neighbours. Any even number of atoms must produce a more vigorous astatic arrangement than an odd number.

Another peculiar feature of chemical affinity, that of the possession of varied bonds of affinity by varied elements, may perhaps be equally explicable on the magnetic hypothesis. It might be that the monad has only one-half the magnetic energy of the dyad, one-third that of the triad, and so on; and that, therefore, it would require two monads to satisfy the magnetic energy of one dyad, &c. This could scarcely be were all the chemical elements prime molecules of matter. The magnetic energy of these could scarcely possess such exact numerical relations. But if the chemical elements be really, in great part, more or less complex compounds of these prime molecules,—if there be but one, or but few, kinds of prime molecules, from whose simpler combinations the chemical elements arise,—then the free energies of the latter would necessarily be in strict numerical proportion. They would comprise sums of equal magnetic units, some of these being masked by their astatic combination, others directed outwardly, and the element would display as many bonds of attraction as it had units of magnetic energy directed outwardly.

There is another chemical condition to which we must here refer. This is, that the quantivalence of an element is not at all times the same, and that, when it varies, it loses or gains two, or a multiple of two, bonds, never—with a few possible exceptions—one or three bonds. This fact is explained in ordinary chemical language by saying that the free bonds satisfy each other, and that, therefore, they must

be in even numbers. But there is no explanation as to how they satisfy each other.

This mystery ceases to be one under our magnetic hypothesis. The free bonds are simply free magnetic poles, and they may be satisfied by magnetic reversal and astatic union in any two of the polar molecules. If, for instance, the five bonds of an acting molecule consist each of a magnetic unit, then one, two, three, four, or the whole of these, may attract monad atoms. But if four bonds be thus employed, the fifth cannot become masked; it can only satisfy its attractions outwardly. If three only be employed, the remaining two may satisfy each other's attractions. Inductive action between them may cause a reversal of poles in one or the other, and they thus become astatically combined. The case is similar to that which is known to occur when a number of magnetic needles are bound together to form a compound magnet. The poles of some of them become reversed by induction. Every one so reversed must mask the magnetism of one not reversed. Thus the bonds of attraction of the compound magnet are reduced by twos with every reversal. If the magnetism of half the needles were reversed the compound magnet would become inert. Each of its poles would have an equal north and south polar energy.

But if, in any such case, a vigorous magnetic energy be brought to bear upon the compound from without, it is not impossible that it might overpower this local influence, and reproduce the original arrangement of the poles. Thus, in the molecule of five bonds, the two masked ones might assume their former conditions, and again display outward attraction.

The graphic formulæ now given in works on chemistry plainly show the application of this magnetic hypothesis to chemical compounds. If, in a complex organic compound, we consider each C, O, H, N, &c., of its formula, as written out graphically, to be a magnet, with a definite attractive vigour of one, two, three, or more units, and that part of these bonds are attached by attraction to equal bonds of other elements, while part satisfy themselves by astatic combination, the formula seems to assume a new phase, and much of the mystery which has enveloped it to yield to the test of this new way of regarding it.

Of course the hypothesis, as so far outlined, does not explain the mysteries of elective affinity. We might reasonably assume that combinations of magnets could be, in no sense, elective in their attractions, and that every two molecules, of whatever character, possessed of free magnetic

energy, would tend to combine. Of course, in the great variety of modes in which magnets might possibly combine, there might be considerable differences in attractive vigour, the magnetic energy of some being employed inwardly, and that of others largely directed outwardly. There might also be great differences in responsiveness to induction, through the different degrees of centripetal magnetic energy. But aside from the phenomena of chemical inertness or activity arising from these causes, there are peculiarities of affinity which need some other explanation.

Elective affinity has some close connection with the electrical behaviour of the elements. As a rule, the most vigorous affinities exist between elements farthest apart in the electrical series, while compounds of these elements display affinities which diminish in vigour as they approach the neutral region between the electrical extremes. It remains true, however, that there are many instances of special affinity which have no definite relation to electrical behaviour.

In static electric attraction and repulsion, it is very possible that the electric condition affects the magnetism of molecules. That electric excitement is an affection of molecules is undoubted, and that it produces heterogeneous conditions in each molecule, yielding the phenomena of electric polarity, is equally evident. If, then, the two halves, or the opposite extremities, of the molecule are put into diverse states of energy by the inductive action of electricity, it is very possible that their magnetic condition may be affected by the same cause. The electric excitement seems to weaken the chemical cohesion of the constituents of molecules, and to cause them to exert a more vigorous outward attraction. But if this chemical cohesion be an effect of magnetic energy, then we might say that the centripetal magnetic energy of a molecule is decreased by electrical excitement, and its centrifugal magnetic energy increased. The electrical induction is an effect of exterior forces, and these may also produce a magnetic induction, weakening the astatic self-satisfaction of molecules, and causing them to seek exterior satisfaction of their energies.

Certainly it is far more likely that the attractions and repulsions of electrised bodies spring from the magnetism which we know to exist in these bodies than that they arise from some unknown attractive condition of matter. That the intimate action of electricity upon molecules might produce effects upon their magnetism, far superior to anything which human experiments with magnets can perform,

is very evident; and it is not at all surprising that substances inert to ordinary magnetic influence should display exterior magnetic energy, when their most interior energies are separated, accumulated at the molecular poles, and their forces directed outwardly.

The character of the attractions and repulsions of electricity is also closely accordant with that of magnetism. Electricities of the same name always repel, while those of opposite name always attract. But we might otherwise express this by saying that electricity converts the molecule into an active magnet, with its one pole always turned to the positive, its other pole to the negative extremity. Suppose, for illustration, that north magnetic polarity were always associated with positive, and south with negative electricity. Then the peculiarities of attraction and repulsion perceived would necessarily arise. A mass affected with induced electricity would resemble a magnet, with its north pole turned to the positive, its south to the negative end. A mass with positive electric charge would form a collection of molecular magnets, each with its north pole directed outwardly, its south inwardly. The magnetic inharmony thus produced would be the result of the electrical inharmony. Nor need this induced magnetism produce stronger relations with the magnetic needle than with other conductive matter. The mass with induced electricity displays the true magnetic attributes, but only towards electrically disturbed substances. The normal magnetism of the needle has no electrifying influence, and conversely is not affected by the results of electric influence.

There is another feature of elective affinity which needs consideration—a certain arbitrariness which must arise from some special cause. And this arbitrary character of chemical attraction may be due to the cause to which we formerly attributed the electrical excitement, namely, to the diversity in the vibratory pitch of molecules. It is exceedingly probable that these divergencies in pitch of vibration hinder the tendencies of molecules to combine, and that no stable combination can be produced unless these discords are overcome, and are modified into harmonies. Two molecules vibrating at closely accordant rates might readily conjoin. Two less accordant in their vibrations must oppose a certain resistance to conjunction. Two completely discordant might utterly refuse to join, they being unable to form a stable combination.

That such variations in vibratory pitch must exist is unquestionable. And that two atoms or molecules vibrating

at discordant periods—in which they might persist to some extent, despite their mutual influence—could not form a stable combination, is equally unquestionable. Although in all such cases magnetic affinity might seek to produce combination, without regard to the special characters of the molecules, this general tendency to combine would be opposed by the special resistance to combination offered by these diverse movements. Two molecules swinging together in unison would support and sustain each other's attractions. Two which constantly darted apart from each other could never form a close union, and would be constantly exposed to exterior energies.

It needs special conditions of isolation from disturbing influences to bring elements of feeble affinity into combination with each other. Such conditions are produced in organic nature, and thus complex molecules are built up whose constituents must display considerable diversities of vibratory pitch. The more intricate these compounds the less coherent are they. Their combinations are only safe while protected from external influences of a stronger character. When exposed, for instance, to oxygen, this element of vigorous affinity disturbs the incoherent union of diverse elements. The varied vibratory swings of the latter hinder them from coming into close and dense union. A certain space must be necessary for feebly accordant movements to take place in, and these intricate compounds, therefore, form molecules of slight density, verging from the solid, through the colloid, towards the liquid. Oxygen seizes, as circumstances favour it, on one after another of the outward swinging atoms or molecules of these compounds, and forms with them molecules of more harmonious motion and intimate elemental relations, so as in time to quite break down the large, but feebly accordant, compound of vibrating molecules.

II. BEAUTY IN THE EYES OF AN EVOLUTIONIST.

By F. Ram.

(Concluded from page 81.)

BARRY, in one of his Royal Academy Lectures, observes that we should not add to woman's beauty by any increase in the number of her mammalian protuberances. But we may safely assert that, if any increase in the number of these protuberances had led to her raising offspring superior in number or viability to those raised under the present arrangement, men would see beauty in this numerical increase; artists would have bestowed them on the Goddess of Beauty, and mammæ in duplicate only would have been repulsive.

One of the many points in which the taste of other races differs from our own is the fondness for extreme obesity which resides in the minds of some savages. Can it be doubted that *Famine*—which has been the chief factor in the production of the bodies and minds of all living creatures—has also been the originator of this strange taste? For the man who desired a fat wife would have been always more likely to have his babes sustained through a time of straitness than one who was contented with a woman who had laid in a smaller store of nutriment on her own person. In a minor degree this fact is seen amongst ourselves at the present day, the leaner females—in the classes in which there is much choice of wives—being more usually left to become old maids. This fact bears witness to the existence of famines in former days. But such a taste could not be expected to be strong in a race whose ancestors secured a scanty living by means of much activity in hunting. Such people would rather pick out their mates with reference to the agility which they saw displayed at some dance or corroborree, and would look rather for grace, or beauty in movement: on which account their descendants perhaps are pleased at the sight of the agility displayed by ballet-girls.

Some parts of the human body are beautiful chiefly by smallness, of which we may instance the shell of the *ear*. This, it is generally now allowed, is a useless rudimentary excrescence, and its maintenance has probably been a mere waste of material for tens of thousands of generations. As the ear-shell must, as is shown by its existence, have been

of use to some far-off ancestors, another reason may have existed for its being subsequently discarded. The powers of an animal's mind depend greatly upon the degree in which it can fix its attention upon one subject at a time. The value of performing monkeys depends very much upon the degree in which this faculty is possessed. And indeed a prolonged fixity of attention upon one point is essential to all great mental results. Hence the fixity of gaze of the genius, as compared with "the eyes of the fool, which run to and fro in the earth." Therefore we may suppose that the distracting effect of a sound-collector might have been injurious to man's advance in intellect.

Bernstein, in his "Five Senses of Man," asserts, with reference to the angle (40°) which would be best adapted to the purpose of collecting sound into the human auditorium, that some persons might object to such an angle "on æsthetic grounds." But it is certain that if such an angle, or any enlargement whatever of the human ear, had been advantageous in the struggle for existence in the past, such an altered structure would have been highly approved "on æsthetic grounds." For, if a maximum ability of collecting sounds had been most advantageous, those who were contented with the appearance of a structure deficient in this way would have had fewer descendants (to carry on their erroneous taste) than those who saw beauty in the greatest spread of cartilage that could be beneficial.

So difficult is it to "find the mind's construction in the face" that little *pro* or *con* my theory can be brought from the expressions of the human countenance. But it may be said that the soft smile which gives an additional charm to a maiden's face, by promising placidity of temper, also promises a man that his infant will not be injured during the period of lactation by the acidity of the mother's mind being conveyed, as is often the case, to the mammalian food.

The sentiment expressed in the French proverb "Il faut souffrir pour être belle," though at first sight apparently adverse to the theory maintained above, in reality supports it. Past suffering may give an additional charm to a beautiful face, because it is evidence of strong vitality, the sufferer being seen to have passed through adversity *without dying under it.* Strong vitality promises many descendants; therefore those who admire any possible visible indication of such trait will have always had a correspondingly good chance of having such æsthetic taste inherited.

I will not dwell, in further detail, upon other special points of beauty which—being correlative to excellences of

body or mind—ensured a numerous viable offspring to those whose mating was regulated with reference thereto.

Though confident that the theory must be correct with reference to those beauties which produce the largest amount of emotion in the susceptible bosom of either sex, I am not prepared to say that the rule is universally applicable. Should the size, shape, or colour of any part of the body be of no importance, in such case, and in such case only, we may perhaps approve of the *average* of what we are accustomed to see. And thus we may dislike a very big or a very small nose, though either may perform its assigned office well enough. Again, some taste relating to a matter of no importance, if there be any such, may be regulated by sentiment. Thus, should an oppressed nation be ground down by a powerful foe notable for bushy beards, patriotic hatred might make bushy beards an abomination; and in the oppressed community a bare chin might be etiquette for ages after the oppressor's yoke had been cast off.

It may strike some minds that, if a theory connecting beauty with the environments is correct, there would be a uniformity of taste in any community, and that there ought also to exist something like a general prevalence of the beauty fitted to the locality. To which possible objection I reply that, in a race dwelling for a great number of generations in one environment, nearly all the members of the community would be very beautiful in one another's eyes. And I have no doubt that wild animals, amongst whom Sexual Selection prevails, are much to be envied in this respect. For as Natural and Sexual Selection eliminate the members of the species which are ugly in the eyes of the same, all the survivors are adorned with qualities coinciding as nearly as possible with the prevalent æsthetic taste. At the same time any animal which man has domesticated must be hideous in the eyes (if still agreeable to the nose) of its wild relatives who have inherited likings which do not accord with the changed appearance given by man to the domestic creature for his own purposes.

The inhabitants of any country which, like those of England, have sprung from ancestors of various environments, cannot of course often be gratified by the sight of what they consider ideal beauty. Change of environment, whether it arise from the migration of a people, or from such fluctuations in the surroundings as spring up now-a-days in every civilised nation, is inimical to the gratification of inherited æsthetic taste. Therefore there cannot be any type of beauty generally accepted in a country originally

peopled as the British Isles have been, even were there no variety of environment therein.

Supposing the environment, by means of Natural and Sexual Selection, makes the beauty accepted by the inhabitants of the locality, how are we to account for the fact that savage nations practise artificial deformities on its members? Only by assuming that the so-called "deformity" is actually beneficial to the race. It does not follow that because we have not yet found out how a flattened forehead is a gain in the struggle for existence, that therefore it is not so. I venture to say that it cannot be materially injurious, and it is certainly most probable that it is in some obscure way a decided advantage; otherwise the taste for it would be weeded out by those having most pleasure in the sight of it lessening thereby the number of their descendants. In such cases, and indeed wherever Sexual Selection acts, we see Natural Selection choosing, as fittest to survive in the locality, the strains which are the possessors of certain brain-cells containing an æsthetic taste.

Amongst artificial deformities must be included the constriction of the waist by English ladies. This practice, though generally now deprecated, will, I believe, come to be understood in time. Women who do not perform more foot-pounds work than is accomplished in a promenade have a good deal more lung-power than they require, and it is a question whether a reduction of the oxygenation done in the body does not lead to a diminution in the amount of food which the digestive apparatus is called upon to deal with. To talk of "interferences with Nature" is not to the purpose; for, as with all other animals, the organs with which mankind are at birth endowed have no reference whatever to their own future requirements, but are fixed solely by the needs of their forefathers, from whom they inherit them.

But whether a tightened cincture is good or evil, the object in the mind of the lady who thus operates on her own waist is to appear "genteel." This natural inherited instinct—the desire we have to appear to belong to the upper ranks of society—springs from the fact that in former times the higher were the *safer* classes, the lower being more likely to perish from want; on which account the proud and ambitious, who strove to raise their social position, left more children (inheriting their traits of character) than those who were content with their natively humble grade. One aim of the slight waist is therefore parallel to that of wearing fine clothes, or any mimicry of a higher rank,

namely, the facilitation of marriage relations with an order having the means to bring up a larger percentage of their progeny. Besides which, the higher classes are more tenacious of life than the lower, because they are sprung from progenitors the length of whose lives enabled them to hoard for their issue that wealth on which alone social position depends. Therefore to marry into a class above one's own is usually equivalent to having children of greater natural vitality—entailing a correspondingly abundant transmission of the ambition to future generations.

The theory of Beauty dealt with in this article relates to the beauty of an animal in the eyes of its own species, and therefore it is unnecessary to dwell here upon that which man sees in brutes, which, if comparable to a human type,—as, for instance, in their optical organs or in their hair,—may be pleasing or otherwise. If not so comparable, they are almost outside æsthetics; for an elephant, or hedgehog, can hardly by their appearance cause more æsthetic emotion in us than a locomotive or a lump of coal.

Of landscape, and the charms which exterior Nature at large has for us, it may be affirmed that our taste must have been formed with reference to the environment, those best pleased with their surroundings reaping such physical advantage therefrom in health, &c., that they were the most viable and prolific in the locality, and so left more descendants, inheriting their taste. If vegetation had been universally red instead of green, and the sky brown instead of blue, those colours would have been thought most beautiful for earth and sky,—not indeed by us, but by those who, under those altered circumstances, would have been selected to occupy our places. If people now living under clouded skies prefer the blue welkin, it is because their race has inherited a love for the same from forefathers who long dwelt under a cerulean vault. The leaden canopy of England will be charming to those living under it when a sufficient number of generations have passed for Natural Selection to have acted on. The love of mountain scenery which some men possess records the fact that their ancestors were benefitted by such a taste, which led them to dwell in localities least accessible to the foe.

The proper subjects for artistic representation are those which are pleasing to our sight by reason of their relation to the *past* environment of our race. We like to see on canvas simple peasants in homely attire, rather than fashionable people dressed in the latest mode. Delineations of steamships, railway trains, and other appurtenances of civilisation, seem out of place on the walls of an academy.

They do not awake, in persons who are æsthetically emotional, the sentiment which springs from the sight of paintings of queer small ships, or boats with quaint old rigging, old tumble-down cottages, or roughly-built carts. The latter sort of things composed our forefathers' surroundings, and not steamships and locomotives. If the latter had borne them over land and sea for a thousand generations, they too would by this time have afforded to the artist fit subjects for his pencil.

But for the extent to which this article has run, some evidence might be added to show that our love or hatred of such sounds and odours as mankind have come into contact with abundantly, have been acquired by a process analogous to that by which man's taste for visual beauty was bestowed upon him.

I have only to add that, although physical beauty only has been referred to in this article, it is clear to my mind that the mode of the origin of man's principal ideas of *moral* beauty must necessarily be closely analogous to that of his main ideas of the physical.

III. MESMERISM.

By N. Gordon Munro.

Doctor.—"You see her eyes are open."
Gentleman.—"Aye, but their sense is shut."

THERE seems to be in this age of scepticism and doubt a prevailing tendency among men of Science to entertain feelings of contempt towards anything which is, even in the slightest degree, invested with the character of the supernatural. Whatever has a tendency to disturb preconceived opinions, or to pass beyond the limits of our present intelligence, is, without inquiry, condemned as an absurd and dangerous innovation. Now this antagonism and habitual resistance to whatever seems new, instead of being productive of good, is nothing more or less than the outcome of prejudice and self-interest, and as such merely serves to interpose obstacles to the advance of Science.

Healthy criticism can by no means be objected to; on the contrary, criticism, in the proper sense of the word, is the auxiliary of truth, and the means by which the true is differentiated from the false. But it surely cannot be called *healthy* criticism where the critic takes his stand under the banner of the *nil admirari*, and launches forth his thunder-

bolts of invective against the invader of his little realm of comfortable prejudices. Are we so very wise that we can afford to jeer at anything which is contrary to what we call the fixed laws of Nature? What, we would ask, are the fixed laws of Nature? Are they not simply the generalisations of human experience? And is it possible that Experience shall instruct us no more? Where are now the persecutors of Galileo, Bacon, and Vesalius? Is Newton still accused of dethroning the Deity? Or is Harvey's discovery of the circulation of the blood still stigmatised as having no foundation in fact, and of being the outcome of a diseased imagination? Calumny is silent, dead, and buried in the obscurity of the tomb, and in its place has arisen a feeling of gratitude towards those men who suffered so much for the cause of truth. "Nor," says Smiles, "is the unjust intolerance displayed towards men in the past without its lesson for the present. It teaches us to be forbearant towards those who differ from us, provided they observe patiently, think honestly, and utter their convictions freely and truthfully."

Let us, then, in dealing with any theories that may be opposed to our convictions, and which are subjected to our criticism, lay aside our opinionativeness, and, with a mind free from petty prejudices, set ourselves to examination and inquiry.

The mysterious and extraordinary nature of the subject we are about to discuss, together with the fact that many of its most wonderful phenomena have been associated in the public mind with the tricks of charlatans and impostors, render it a matter of peculiar difficulty for us to treat of it in a scientific and methodical manner. In pursuance of this object we shall at once plunge *in medias res*, without entering into a detailed history of the science, improperly so called.

Before, however, proceeding to ascertain, if possible, the established relations between the effect and its cause, we would say that the art which is now most generally comprehended under the name of Mesmerism is undoubtedly of very ancient origin, dating probably many centuries before the birth of Christ. Not that it then existed as a distinct agent, but, floating under various garbs along with the germs of Astronomy and Chemistry, it entered largely into the arts of Astrology and Magic.

It is not our intention, nor indeed will space permit us, to enumerate in detail the phenomena which characterise the effects of Mesmerism on the human system. Suffice it to say that by the application of artificial means, the *rationale* of which will shortly be discussed, it is possible to

induce, in certain individuals, a state of trance closely analogous to Somnambulism, or sleep-walking, and characterised by the presence of phenomena of so marvellous a nature that, unless supported as they are by the most incontrovertible evidence, they would inevitably be regarded as fictitious.

We shall now proceed to the consideration of the supposed causes of those psychological and physiological phenomena which accompany that peculiar state of mind and body known as the Mesmeric Trance. These causes classified and enunciated take the form of two conflicting theories. The theory which first presents itself for examination—namely, that of Animal Magnetism, or Mesmerism proper—was first advanced by Anton Mesmer, a native of Musberg and an M.D. of Vienna, and has subsequently been promulgated by most votaries of Mesmerism. It is to this effect:—"There exists in Nature an imponderable fluid which can disengage itself from one body and be transmitted to another, and by means of which man is enabled to exercise over his fellow-creatures a singular and unaccountable influence." This fluid, which is supposed to resemble electricity in some of its properties,—namely, that of attraction and repulsion,—and in possessing two poles, is stated to be developed in the tissues of the human system by the decomposition of its molecular constituents, thus bearing an evident analogy to the manner in which the electric fluid may be produced. The body is, for various reasons, supposed to be not only a generating machine for this fluid, but a magnet in the proper sense of the word. If this be the case we may safely assume that any two selected points may be taken to represent the respective poles of the magnet. The hands, or distal ends of the upper extremities, are taken for obvious reasons,—viz., the nervo-electric fluid before alluded to is collected in the nerve-centres of the system, and, conducted by the nerves themselves, radiates to the general surface of the body. It is not then improbable that in the feet and hands, where the nerve-trunks break up and ramify so completely, the emanations from these surfaces will be considerable. This consideration, together with the fact that the hands form a ready means of transmitting the fluid, sufficiently explains the origin of the mysterious passes made by the operator over the body of the subject. In like manner it is supposed that this fluid passes from that great nerve-centre, the brain, along the optic nerves, to the eyes themselves, and from thence to the surrounding medium of air. It is further surmised that by the intense concentration of

will this fluid is evolved in larger quantity, just as the amount of nerve-energy required to stimulate a muscle can be increased by an effort of volition. By attributing to this fluid some unknown reflex action, the advocates of animal magnetism attempt to account for the mesmeric phenomena.

Although to the eye of the superficial observer the above explanation may appear highly irrational, yet further investigation proves it to be not altogether unsupported by facts, and as such it demands our closest attention.

During the investigations of a committee of the Royal Academy of Medicine at Paris, appointed for the purpose of testing the accuracy of the mesmeric phenomena, it was observed that, in certain stages of the trance, the approximation of the fingers of the operator to any part of the body of the subject was attended with the production of involuntary muscular twitchings in the opposed surfaces. Subsequent investigation has confirmed these observations, and numerous facts of a like nature might be recorded,—*e.g.*, the application of the finger over the sterno-mastoid muscle causing contraction of its fibres, &c.

Now, in order to show the full significance of these facts, we must go a little into detail.

It is a well-known physiological fact that the contraction of a muscle is due to a series of extremely rapid chemical changes taking place in the muscle during the period of contraction. In order to supply material for these chemical changes the muscle requires nourishment. This it obtains from the blood. It is apparent, then, that in a properly nourished muscle, before contraction, there is an amount of energy stored up, or, in other words, the materials for the chemical change are there, but they require to be *stimulated* before chemical action can take place. How are they stimulated? By the nerve energy. This energy or force,—call it what we will,—passing along the nerve to the muscle, acts as a liberating energy or stimulus to set a-going this chemical change. Various other agents—*e.g.*, mechanical, chemical, thermal, electrical, and stimuli—are likewise capable of inducing these changes.

Now in endeavouring to account for the before-mentioned facts, for want of a better explanation we are forced to come to the conclusion that some species of energy, possessing the same power as electricity, but probably to a lesser degree, passes from the finger to the nerve, and either reflexly or directly stimulates the chemical molecules of the muscle, thereby causing contraction. This is, of course, a mere hypothesis, but the following experiment, which certainly

seems to indicate the existence of such a fluid to a certain extent, enables it to assume the character of a certainty:— Several tumblers containing pure cold water are placed on a table a short distance apart, and passes are made over any one of them. The mesmerised subject, on being brought into the room, will, on tasting in turn the water contained in these tumblers, immediately recognise the one over which the passes were made, at the same time giving demonstrative evidence of his dislike to the water contained therein.

The above experiment we are thoroughly convinced is in every sense trustworthy, we having performed it several times, and in every case with complete success. It is mentioned in most works on Mesmerism, and is recorded by the late James Gregory, Professor of Chemistry in the University of Edinburgh, in his most interesting work on Animal Magnetism. Other experiments having the same end in view have been successfully performed, but are too elaborate to receive attention in a short treatise like the present. We may just mention that Gregory, Colquhoun, Reichenbach, and many competent authorities assert that to sensitive persons in the waking state, and the majority of subjects in the mesmeric trance, the emanations of this fluid are visible, appearing as faint luminous streaks of light shooting from the tips of the fingers. Our own experience, however, precludes us from passing an opinion on the subject, and it would therefore appear unphilosophical for us to adduce these statements as proofs.

The upholders of the anti-magnetic theory maintain that these phenomena are merely the result of the tiring out of that portion of the brain which presides over the action of the judgment, thereby rendering the will of the subject subservient to that of the operator. Their principal argument lies in the fact that it is possible to induce certain of the mesmeric phenomena by such means, viz., by causing the subject to gaze for a sufficiently long time at a fixed object, such as a coin. Starting from this particular premise, they proceed, by a train of reasoning as ingenious as it is fallacious, to the general conclusion that all the mesmeric phenomena are produced in like manner, the subject being (they state) placed under conditions in which there is a continued strain on, and consequent tiring out of, the mental faculties. Now, apart from the consideration that the explanation set forth in this argument is not calculated to throw the faintest ray of light on the remote causes of the psychical effects which manifest themselves in the higher stages of the mesmeric trance, it is hardly necessary to state that it is opposed

alike to logic and common sense. It assumes that because certain phenomena are produced by certain means and under certain conditions, therefore it is a physical impossibility for the same phenomena to be produced by other means and under other conditions! What if we were to argue that because complete insensibility may be occasioned by pressure on a certain portion of the brain, it must follow, as a necessary sequence, that it is impossible for chloroform to produce the same effects, or, granting its ability to do so, its action must be to produce compression of that part! Would it not be said of us that we were sadly deficient in regard to that very necessary article—*nous?*

Nothing is further from our intention than to deprecate the fact that the mesmeric trance may be produced by the above means. We simply wish it to be understood that, besides occurring naturally, the trance may be produced by other means, and that it is not improbable that both these means are adequate to the effect. This is further borne out by the fact that patients may be mesmerised when asleep, and consequently under conditions entirely different from those which are necessary for subduing the action of conscious volition. This is no fiction; it is a fact, and is attested to by men whose honour and integrity are above suspicion.

When we consider the energetic nature of the opposition which has at all times been brought to bear against the theory of animal magnetism, we are inclined to think that there must be other reasons than these for denying the existence of this fluid. Are there, let us ask, any theoretical grounds for supposing that such a fluid can have no existence? Are there any reasons why, physiologically, it should be impossible for a fluid possessing these properties to be connected with vital organisation? Is there not direct evidence to the contrary? Are you not aware that in your own body, whenever a muscle contracts, whenever nerve energy is propagated, and in all probability whenever an idea is generated, electricity is evolved? Take also the case of the electric ray, or torpedo, a fish possessing the remarkable power of discharging, when irritated, powerful electric shocks. Regarding the electricity produced by this animal, Prof. Alleyne Nicholson thus observes: "The identity of the force produced in this way with the electricity of the machine has been demonstrated by many careful experiments. . . . There is no doubt, however, that the force which is expended in the production of the electricity is merely nerve force, for every equivalent of electricity which

is generated the fish loses an equivalent of nervous energy' and for this reason the production of the electric force is strictly limited to the amount of nerve force possessed by the animal."

Again, in his concluding observations on the electric eel, Humboldt remarks, "That which constitutes the invisible weapon of these inhabitants of the waters; that which, awakened by the contact of moist and dissimilar particles, circulates through all the organs of animals and plants; that which, flashing amid the roar of thunder, illumines the wide canopy of heaven; which binds iron to iron, and directs the silent recurring course of the magnetic needle—all, like the refracted rays of light, flow from one common source, and all blend into one eternal all-pervading power."

That mysterious and occult influence the consideration of which has occupied the greater part of this paper is considered by many authorities to constitute what is known as the "*Vis Vitæ*," or vital principle; but this view is hardly acceptable, and whether in its ultimate essence it is merely a subtle modification of the electric force is a question which, in the present imperfect state of our knowledge, we are not justified in answering. The fact is that here we reach the legitimate boundary of fact, and beyond the demonstration of the existence of this fluid, and its probable connection with the mesmeric phenomena, all else is mere speculation.

For many years animal magnetism has been in vogue as a curative agent, but qualified medical men are averse to its practice, and, from the unsatisfactory nature of the results which frequently attend its application by empirics, we doubt very much if its use should be recommended.

The immense amount of light which the study of Mesmerism is calculated to throw on the science of Psychology ought to be a sufficient inducement to us not only to collect facts, but to study, and if possible to classify, them. Let us not remain satisfied with the meagre information we already possess, nor leave to future investigators a task which it is our duty to perform.

IV. PLEADING FOR A GEOLOGICAL IDEA.

By O. REICHENBACH.*

Amendment to Laplace's Nebular Theory.

A NEBULA with unconfined room for expansion has no high temperature. The generation of a stellar system requires centres, solid atoms, to begin with, which, by exchange of attraction and repulsion, assign limits to the nebula, and by concentration of matter and increase of empty space produce oscillations of temperature, regularity of motions, composition, decomposition, and transformation of atoms and molecules. The beginning of a solar system is therefore not the concentration of a sun within detaching rings rolling up to planets, but the opposition of solar and planetary centres, round which matter gets grouped into rings divided by more or less empty spaces, and into strata separated by nodal bands.

A nebula must be either a collection of smallest spaces growing force from nothing, or a collection of such spaces set free by the collapse and death of such systems productive of heat, of high molecular centrifugality, of decomposition of mass, and of compound and simple molecules and atoms. Such a nebula, with re-incipient evolution, will produce heat and light by again passing into condensation, transformation, and combining motions.

Spectral analysis therefore confirms that the more diffuse and without centres a nebula appears, the more backward it is in evolution, the more primitive are the substances composing it, and the less is its volume of motion, the volume described by its translatory motion in space, and the velocity of such motion.

Generation of a Solar System.

A solar system is engendered by the action of two or more systems on nebula in its nascent state. The planetary mass of our system, opposed to the solar mass, became

* As contained in "Some Properties of the Earth," by O. REICHENBACH, published by Wertheimer and Lea, Finsbury Place.

divided in a manner and order described by me in "Gedanken," 1857, p. 113, and in "Two Planets beyond Neptune," 1875.*

The evolution of the system progressed by atomic and molecular union, which consisted not only in the development of new combinations of single and compound atoms and molecules, but in the combination of simple to simple atoms, embracing within a smaller space the same measure of attractive force as in the sum of spaces of greater volume formerly occupied by them.

I have shown that molecules consist of rings, of strata round one or more centres or nuclei. I have shown that the evolution of masses acting on each other in vacuum develops similar results.

I have shown that the sun moves, in probably 11,500 years, round an immaterial centre, in an orbit whose eccentricity and extent is determined by itself and by planetary action. This solar year has its apsidal and latitudinal seasons, because the orbit is eccentric and the orbits of the planets are inclined to the equator of the sun.

I have pointed out, in speaking of heat and light, the existence of an interchange of matter between heavenly bodies, which is besides evident by the fall of meteors.

Catastrophes.

I have shown the part played by the relation of solid and fluid masses in the eccentricity of orbits of planets and molecules, and the changes that must occur in solids, liquids, and gases in passing from state to state. I have shown that such changes lead to catastrophic phenomena in and between molecules, and in and between stellar masses.

Every inorganic or organic individuality or species has the more quick course of its development crossed by sudden changes. Are not begetting, birth, teething, the first word after the habit of hearing, manhood, death, catastrophes?

When the attraction of a planet or a comet, added to that of the sun, may alter a hyperbolic or parabolic course into an ellipsis or a spiral leading to sun or planet, the accelerating attraction of sun and planet may cause such an

* To be found by those who care at the British Museum. From them it may be learned that Dr. G. H. Darwin's theory that our moon is the offspring of the earth, admired by Professor Ball, and made the start for a too hasty speculation by the Rev. Prof. Fisher, is not quite new. What is true and what is erroneous in the application of the theory by Dr. Darwin I shall not here discuss.

increase of rotation,—that is, of heating of the inner solid comet,—and such a relative increase of the quantity and pressure of its fluid portions, that the comet going to perihelion gets divided or dispersed, or may have its progressive motion reversed, or its elliptic orbit made parabolic or hyperbolic. The division of Biela's comet in 1846 has demonstrated that my hypothesis ("Weltgebaurde," 1845, edt. Bauer), that our earth is the offspring of a larger planet, was no absurdity.

Birth of Moons and Rings.

I have shown why and how the earth moved in a most eccentric orbit, intertwined with the orbits of other planets, and threw off Mercury. I have shown how after a time, in moving in a less eccentric orbit, it gave birth to our moon.

After the separation of the moon, when the eccentricity of the planet and of its orbit was diminished yet considerably, it turned off rings. Saturn, the least dense of planets, proves that such rings may exist. The turning off of rings was a series of catastrophes for the earth and its molecules.

The leaving of moons and rings is likely to occur in the equator of the planet, but it need not be, because the equator is not of absolute necessity the plane where centrifugality is greatest. Any inequality of mass of the planet to the sides of the equator, or any outside attraction not falling with its maximum in the equator, must produce an inclination of the plane of motion of the satellite to the equator, and therewith a continnous oscillation of the respective planes.

Moon or ring need not revolve in the like sense as the planet, because at the time of the catastrophe the inequality of mass and density, and state of substances, originally and by position of sun and disturbing planets, may have been so great between the polar hemispheres that the increased centrifugality operated in preference on one hemisphere, what resulted in such a height and velocity of descent of the overbalancing mass towards the equator, and consequently in such a pressure and velocity of parting ascent (velocity in a polar trajectory) on the other side, that the separated mass acquired an orbit with so great an inclination to the equator of the progenitor that the motion of the globular or annular satellite, itself less dense than the central body, became retrograde—a condition which may become reversed after condensation and reduction of inclination, and a modification in the relative proportion of masses and

densities of the two bodies. Several observers think that the volume of Saturn to both sides of its rings or its equator differs considerably. Similar observations were long ago made by Schubert with regard to Jupiter.

Displacement of Axes.

A displacement of weights external to the planet must produce a reciprocal displacement of density and weight within the planet, and a displacement of its axes in space. Take a planet covered by liquid, and assume solid and liquid to have at starting the axis of revolution in common: any disturbance of the distribution of the liquid by an outside mass will break the continuity of this common axis, because the densities and compressibilities of solid and liquid differ. These changes must occur when a shell is divided from a nucleus by one or more strata of more elastic nature than either, and when the shell experiences from the outside or inside perpendicular and tangential pressures which produce friction, heat, chemical action, alternations of solidity, liquidity, and gaseity, and metamorphism through a condensation of the interior below a contracting outside. A mass condensed at the outside in its aphelion period may produce moons and rings in its perihelion when the interior is compressed and the outside expanded.

Condition of Rings.

The rings are composed of solids, liquids, and gases: they are closed zones, separated from the central mass by vacuum. After separation the tendency to reunion commences. The rings condense by molecular changes; they cool; they intercept the rays of the sun, but are compressed by its centrifugal reaction and by its co-attraction with the planet; they congeal; the solids gain in proportion to liquids and gases.

The central mass also cools. It gains less in velocity of rotation than it gains in density. It gains in velocity of motion round the sun; the orbit contracts, and with the sun in space. Centrifugality at its surface becomes a less percentage of attraction, the volume within which gravity exceeds centrifugality gets extended, and finally overreaches the contracting ring. The ring gradually descends and falls, starting for the planet at aphelion time; it becomes contiguous to the planet as a catastrophic rain, as a cataclysm with liquids, solids, and gases. It brings on a period of

meteor showers, earthquakes, electric commotions, and magnetic constitutions.

Such joining of a ring must modify the revolution of the ring and the rotation of the planet. It must alter the eccentricity, and even the mean axis of the common orbit round the sun.

Spreading of Rings.

Such a descent of mass produces friction and heat. Molecular centrifugality is developed, and tends to again lift the ring from the planet where centrifugality is greatest. The mass of the lifted ring is re-attracted towards those parts where centrifugality is least, towards the higher latitudes and polar extremes, from where it again streams and tends towards the equator. Its fluid matter circulates round the planet. The ring becomes an envelope, which divides and settles according to specific weights and molecular qualities and affinities, and becomes a new shell, and sea, and atmosphere, under the attractive influences of the planet and the perturbing sun.

Tangential Action of Rings.

The fall, spreading, and revolution of the ring, growing into an envelope, constitute in contact with the planet, under the perturbing action of the sun, a combination of tangential forces, which, in proportion to the weight and motion of the new ring, operates on a corresponding envelope or section of the older planet. It develops and maintains friction and heat below this section. By the heat they produce these tangential forces soften, liquefy, and gasify, expand, lift, condense, compress, and metamorphise below the old envelope, and which they so fold, plicate, push, shove, and partially lift. The descent of ring after ring is a series of catastrophes divided by developing modifying periods.

The own eccentricity of the planet constitutes the leverage by which the descending, slower and slower revolving ring acts on an envelope of a weight proportional to the weight and motion of the ring.

Sliding of Envelope.

Most geologists consider it absurd that a solid envelope, or series of shells, of which the lower have partly penetrated the upper ones, resting on an elastic, locally yielding,

and rising liquefying interstratum, has slided, and slides partly and together, most slowly over a nucleus.

Does not stone turned on stone, by wind or water, produce heat and do work? Have not those ice sheets about which we hear so much and know so little slided and grinded, solids over solids, heating and melting below them by weight, and by height and velocity of descent, and by interception of heat, radiated from the inferior solid? What difference is there in all this between ice and azoic rock but the degree of heat required for melting either?

The ring developed into a globular envelope moves at contact round the planet. It forms with it a vast kind of a compound—not yet of a simple—molecule of not accidental proportions and characteristics.

Every geologist speaks of folds of every thickness and extent—feet, miles, mountains. The continents are the folds of an envelope over an earth limited in the mass by the revolution of a plane curve. It is impossible to form folds over such a body without that every molecule composing them slides away from that radius in whose prolongation it was situated. When every molecule must slide, the folds, the continents, the envelope must slide, it is tangentially pushed and drawn.

The pushing and drawing, and the resistance to either, vary in direction and periods for any and all of the strata. Folds form, unfold, and reform, like waves; new shapes and directions arise within and under, forming and transforming sediments and denudations.

What I show.

I show in which manner the folding and sliding has proceeded and proceeds. The theory that a shell, formed over an intensely hot fluid, broke and drifted like floes of ice on a pond moved by wind, and again baked to a sea-bottom, and piled up to continents helter-skelter, is a sham. The earth is not a rotten cringed apple; and even an apple does not rot and wrinkle without an order in the causes of disintegration.

I show that our continents amidst our seas have been formed gradually and regularly, according to physical laws, by orderly working forces, and that this order has produced a symmetry of arrangement which may be made visible and intelligible to every educated mind not blind and deaf by professional pride or envy, or in the heart's heart disposed to prey with plagiatory instincts on the fragments of a work incomprehended in its fulness.

I show, and shall show, that this development with its catastrophes throws lights on the probabilities of the origin and evolution of organisms brighter and truer than those of natural selection, howsoever dim Will-o'-the-wisps they may also be, and remain to guide us in our knowledge of the eternal infinite.

I refer to certain globes and maps, and point out the visible, about which there can be no spirit-knocking imposture, sometimes attracting the learned. It has all the authority of experiments performed by untutored Nature in its boundless laboratory; it presents all the diffractions and interferences of manifold laws, sprung from an universal law.

Should anyone say of this or that regularity or coincidence "I had seen it, I knew it," I ask where and when did you say so? And if there should be a sufficient reply, I shall gainsay you said so after my time, and never traced the origin and connections of such fact, the "*encheiresin naturæ*." I did not pick up these facts, suggestive of greatest probabilities, as the schoolboy does the capitals on the map. I got at them by reasoning more intricate than that which led the grandly adventurous spirit of Columbus to search for the ancient East by sailing West; and when a definite point had been gained and was confirmed by the visible I went on.

I maintain that there is law and order on earth and in heaven more than sought for and expected, and to all who might venture to pronounce that password of ignorance, Accident, I tell—Pythagorean ideas and the teachings of Aristarchus of Samos were rejected, suppressed, and silently made away with by orthodox Science. Ptolemean muddle, not without meritorious art, dominated in the progress of doctors and the creeds of the faithful multitudes. Copernicus finished his "De Orbium Cœlestium Revolutionibus" in 1530, but the instinct of self-preservation made the high ecclesiastic delay its publication to the hour of his death, in 1573. Galileo Galilei had to repent for his "Dialogo," of 1632, to the end of his days, in 1642. Kepler led the life of a vagabond after his "Astronomia Nova" appeared in 1609, and he starved in 1630. Tycho Brahe, the contemporary, the great observer, saw that the orthodox system was wrong, but jealousy urged him to oppose the progress of truth by own errors. Statues they now all have.

V. DISTINCTIONS BETWEEN ORGANISMS AND MINERALS.

CERTAIN recent investigations have shaken, if not altogether overthrown, one of the most striking distinctions between the inorganic and the organic worlds. Suppose we take up one of those bodies in which dead matter is individualised, *i.e.*, a crystal. We perceive at once that its surfaces are planes, bounded by right lines.* We may by grinding and rubbing bring such crystals into rounded forms, and nature may effect the same if the crystals lie in the bed of a rapid river, or on the shore of the sea. But these forms are essentially artificial, and are never assumed when inorganic matter is left to crystallise. On the other hand, if we take an animal or a plant and examine its shape we find that save in some of the lowest groups it has exclusively rounded surfaces, spherical, spheroidal, ellipsoidal, cylindrical, &c., and that its outlines are curves. This distinction between the living and the lifeless is so striking that it was once proposed to view the development of animals and vegetables as a process of curvilinear crystallisation, peculiar to certain kinds of matter when placed under proper conditions. The immense mathematical difficulties involved were the reason why the idea was never worked out.

Again, if we break, cut in pieces, or otherwise dissever a mineral and an organism we find that their respective differences of structure are not confined to the outer surface. The disintegrated particles of the mineral body are each solid; each, if cut or broken, consists, within and without, of the same kind of matter. We may find in minerals, *e.g.*, asbestos, a fibrous structure, but such fibres are not tubular, and never contain either a fluid or any solid body differing in composition or in structure from the outside layers. In the organic world all this is otherwise. If we examine the intimate structures of the plant, or the animal, we find tubes, sometimes hollow, sometimes containing a fluid, or sometimes a solid matter differing in its nature from the enclosing walls. We find also round or oval vesicles known as cellules and generally containing fluid matter. These well-known contrasts are presented here in the briefest and most sketchy manner, not as being in themselves novel, but as necessary to be borne in mind for the understanding of what is to follow.

* The partial exception in case of the diamond—carbon—is insignificant.

In February, 1878, M. Georges Fournier, of Paris, performed, in presence of Mr. W. Crookes, F.R.S., and of the present writer, some most remarkable experiments. By mixing together certain inorganic salts he produced pseudo-organisms which, in form and structure, might easily have been confounded with certain cryptogamous plants by any one who was not acquainted with their origin. In the belief that M. Fournier was continuing his experiments we considered it a duty not to make his results known in a premature and necessarily incomplete state. It was, therefore, with regret and surprise that we saw in the "Comptes Rendus" for January 2nd, 1882, a memoir by D. Monnier and C. Vogt, a translation of which follows:—

"Figured elements presenting all the characteristics of form belonging to organic elements, such as cellules, simple and with porous channels, tubes with sides, with septa, and with heterogeneous granular contents, may be produced artificially in an appropriate liquid by the joint action of two salts forming by double decomposition one insoluble salt or two such. The one of these salts must be dissolved in the liquid, whilst the other must be present in a solid form.

These organic elements, cells, tubes, &c., may be produced either in a liquid of organic or semi-organic source such as the saccharate of lime, or in an absolutely inorganic liquid, *e.g.*, silicate of soda. Hence there can be no longer any question of distinctive forms characterising inorganic bodies on the one hand and organic on the other.

The formation of such pseudo-organic figured elements depends on the nature, the degree of viscosity, and the concentration of the liquids in which they are produced. Certain viscid liquids, such as solutions of gum arabic, or of zinc chloride, yield nothing of the kind.

The form of these pseudo-organic products is constant with reference to the salts employed, as constant as any crystalline form of minerals. This characteristic form is so well maintained that it may even serve for the detection in mixtures of a minute proportion of a substance.

The form of the artificial pseudo-organic elements depends principally on the acid which enters into the composition of the solid salt. Thus the sulphates and the phosphates produce tubes, whilst the carbonates give rise to cellules.

With some exceptions, such as copper, cadmium, zinc, and nickel sulphates, the pseudo-organic forms are only produced by means of substances which are found in real organisms. Thus the saccharate of lime produces organic forms, whilst those of strontia and baryta do not.

The artificial pseudo-organic elements are enveloped in true membranes possess ng a high degree of dialysing power, and giving passage merely to liquids. They have heterogeneous contents, and produce in their interior granulations arranged in a determined order. They are, therefore, in form and constitution, absolutely similar to the histological elements of organic beings. It is probable that the inorganic elements contained in protoplasm play a certain part in the constitution of the figured organic elements.'

The close similarity, both of the means employed and of the ends reached by these authors, and by M. Fournier, is very interesting. Silicate of soda was one of the compounds used by M. Fournier, and salts of nickel played a prominent part in some of his most striking results. After having thus vindicated the claims of my friend I must attempt to show some of the bearings of this discovery.

It must be admitted that the structures produced are merely pseudo-organisms. They manifest none of the phenomena of life. They do not take in, assimilate, and excrete any kind of matter. They do not propagate. Nor does it appear that if carefully preserved under constant conditions they might not continue to exist for an absolutely indefinite time. They have, therefore, no vital cycle —no periodicity.

Nevertheless we must note the points in which they seem to link the organic and the inorganic worlds together. As MM. Monnier and Vogt urge one of the characters by which mere lifeless matter was till yesterday differentiated from the living organism is wiped out. There are no longer any distinctive forms by which we may distinguish the two great classes. Here a new thought will suggest itself to every reader: these pseudo-organisms have, so far as we know, been obtained experimentally only by M. Fournier, and by MM. Monnier and Vogt. But is it not very possible that such structures might be produced without human intention and interference in what we call an accidental manner? Might they not, considering the large proportion of silica which they contain, become preserved for ages, and continue to display pseudo-organic features? Suppose we find in a rock certain structures exhibiting apparently organic cells, are they the remains of true organisms or of pseudo-organisms? This consideration—at least till it has been further studied—is not without its bearing upon such questions as the organic or mineral nature of the structures found in meteorites, and, *e.g.*, of *Eozoon Canadense*.

It is highly significant that, with certain exceptions, the rationale of which may become clear on future scrutiny, only those chemical elements which occur in natural organisms are able to take part in producing these pseudo-organisms. Chemists fully recognise the close analogy which exists between lime, strontia, and baryta. Yet whilst the saccharate of lime lends itself to organic formation the corresponding salts of strontia and baryta are excluded. This consideration is of grave import. It would seem to follow that certain chemical compounds are capable and naturally tend to produce organic structures, cells, tubes, &c., under certain conditions just as under others they give rise to crystals. But MM. Monnier and Vogt have gone even further, and have been able to specify the classes of structures which different compounds may form. They state that sulphates and phosphates originate tubes, whilst the carbonates give rise to cells. May not these facts have their meaning, to be traced out perhaps in some country where biological research is free? May they not throw light upon the functions of different classes of salts in the process of nutrition? Has the attempt been made to quicken these pseudo-organisms into a higher stage of existence by the application of varying conditions of atmospheric pressure and composition, of light, temperature, &c.? At any rate these growths seem to be, from a structural point of view, a transition-stage between the unequivocally inorganic and the decidedly organic and vitalised. It is conceivable at least that such has been the path taken by Nature.

Apart from all special scientific considerations the experiments of MM. Fournier, Monnier, and Vogt have a philosophical value as confirming the principle of continuity.

We must take the liberty of here calling attention to certain researches which, though not in direct connection with the experiments of M. G. Fournier and of MM. Monnier and C. Vogt, serve in some degree to lessen the gap between the organic and the inorganic worlds, or at least to throw light upon the cause of life from a chemical point of view.* Our readers are, of course, aware that sixty years ago all organic compounds were supposed to be due to the action of a distinct vital force, and to be quite incapable of artificial production. In 1828 Woehler succeeded in constructing urea from dead matter. Since that time not a few organic compounds, formerly obtained only from plants and animals

* Die Chemische Ursache des Lebens, Von Oscar Loew und Thomas Bokorny. München: J. A. Finsterlin.

—such as alizarine, indigo-blue, vanilline—have become laboratory products. But chemists have failed in the synthesis of the more characteristically vital compounds, such as albumen. Further, till the year 1875, the idea of a chemical distinction between living and dead protoplasm was not even conceived. Prof. Pflüger ("Pflüger's Archiv.," x., p. 251) advanced the opinion of a necessary chemical difference between protoplasm in these two conditions. It may be well here to remark, for the benefit of such readers as are not conversant with modern bio-chemical research, that protoplasm is not an abstract idea or a mere theoretical body. It is a substance which can be obtained from certain plants—*i.e.*, *Ethalium septicum*, and submitted to the investigations of the chemist and the microscopist. The idea was taken up by HH. O. Loew and Thomas Bokorny, of Munich. The former of these chemists in establishing a rational formula for albumen was struck by the circumstance that it contained a number of aldehyde-groups immediately bordering upon amide-groups. Such groups, according to modern chemical philosophy, must be distinguished by intense atomic motion. Hence, argued Herr Loew, this motion constitutes life, whilst the respective displacement of the aldehyde and amide-groups, and the necessary cessation of the atomic motion involves death, it may be of a mere molecule of protoplasm, or of a larger portion, or of the entire animal or plant. Now, so far, we have to deal merely with a theoretical assumption. This point requires, therefore, a little further explanation. The methods of the astronomer are utterly unintelligible to the majority, even of educated men. But when an astronomer on theoretical grounds predicts the existence of a hitherto unseen planet, and another, turning his telescope to the spot, discovers it there as foretold, the public is forced to admit that the hypotheses of astronomers deserve a great degree of confidence. Very similar is the case with the speculations of the chemist: no man has seen a molecule, much less an atom. No man can say, on the direct evidence of his senses, that in a molecule the atoms are arranged in this or the other manner. Nor has anyone witnessed the more or less rapid vibration which the atoms in a molecule, or the molecules in a compound body, are inferred to undergo. But when we find chemists setting out from these assumptions come not by chance but intentionally to such results as the formation of artificial indigo, they are entitled to claim for their assumptions at least provisional acceptance.

HH. Loew and Bokorny, however, were not content with-

out testing their supposition experimentally. They found that living protoplasm has the power of reducing silver from a very dilute alkaline solution, whilst in dead protoplasm this property is wanting. By dint of a long course of investigation they determined that this reduction could be due merely to the presence of the aldehyde-groups in the protoplasm whilst living. In living protoplasm the aldehyde-groups of each molecule are brought in immediate proximity with the amide groups of the next, and thus a considerable intensification of the vital molecular motion ensues. But with increasing complexity and motility follows increasing instability. Apparently trifling agencies displace the molecules and their action ceases. During every such molecular displacement, which is in fact a combustion, heat is liberated. Hence the rise of temperature in fevers, and that which occurs upon death. On the other hand, when lifeless albumen is assimilated and converted into the protoplasm of a living cell, heat becomes latent. The absorption of oxygen, and the formation of carbonic acid, in short, the whole process of respiration, becomes intelligible, since it is admitted that an increase of molecular motion promotes chemical action and consequently oxidation. Vital force, Herr Loew considers to be, in short, reducible to the tension of the aldehyde groups ultimately due to electric differences. Life is the total result which the protoplasmic structure yields by means of such vital force. Space does not allow us to reproduce here the experimental evidence which the authors here set forth in support of their theory. They trust that at any rate the first step has now been taken towards explaining the numerous mysteries which appear in the manifold functions of protoplasm. Even the cardinal problem, the first origin of protoplasm upon our earth, seems to them only a question of time.

Whilst wishing the authors good speed in the arduous task they have in hand, and whilst admitting that they have laid down a fair working hypothesis on the nature of life, which must stand or fall by its results, we wish to point to one difficulty. They appear to regard albumen and protoplasm as substantially identical in composition. Now, according to the analyses of Reinke, referred to in the "Journal of Science" for 1881, p. 182, protoplasm contains scarcely 30 per cent. of albuminous matter, and contains upwards of 40 proximate principles. The question now arises whether all these principles are truly components of the protoplasm molecule?

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

TECHNICAL Education is still a subject little understood, not only by the general public, but likewise by not a few Members of Parliament, and by some of our leading Statesmen: they confuse and jumble together, whenever they speak or write on the subject, the technical education required by the workman and the technical education required by directors of industries, whether masters or managers. We shall discuss these two forms of technical education separately, and in doing so we shall not confine ourselves to education pure and simple, for the subject requires to be treated in a much broader aspect at the present time. We shall have to notice the defective machinery we at present have for carrying out technical education; for defective it is admitted to be by the present political chiefs of the Education Department, by Members of Parliament, by our manufacturers, and by many scientific men, otherwise the recent appointment of a Royal Commission to inquire into the methods adopted for imparting technical instruction in Germany, France, and other continental countries, would have no meaning: the Commission has been appointed avowedly to inquire into the systems of technical instruction on the Continent, with the object of improving our own.

Concurrently with the investigation the Commission is making, negotiations have been proceeding between the Governments of England and France for the ratification of a new commercial treaty; and the difficulty which stands in the way of a satisfactory termination of the negotiations is due, as most people know, to the excessive import duties which the French Government wish to levy on many of our manufactured goods, whilst we admit their goods free of duty. And it is not alone, as many suppose, on goods that require for their production little human skill, but also upon manufactured articles that require considerable skill in their manufacture. What transpired at the meeting, on the 14th of November last, between the silk-weavers and the Under-Secretary for Foreign Affairs, Sir Charles Dilke, with respect to the Anglo-French Treaty, affords a very good illustrative example.

Mr. Buckingham, who introduced the Deputation, stated that "the silk trade of Spitalfields was divided into several

interests. There were the broad and narrow weaving, the velvet weaving, the figured silk weaving, the upholstery weaving, and the trimmings; all of which would be affected still more by the proposed new treaty, unless something better were done than existed at present. All English articles of pure silk were admitted free into France; but during the last twenty-five years competition had been so keen, in consequence of England admitting every article of silk manufacture free, that our manufacturers were put to their wits' ends to know what to do to meet the severe character of that competition, and also the great demand for cheap articles. The consequence was that in the velvet industry, where cotton was used in its manufacture, the foreign manufacturer—particularly of France and Germany—was able to compete with us on better terms than we could do; because as soon as cotton was introduced into the article of velvet manufacturing, *we were shut out from every other country by systematic high duties*. Consequently velvet goods were things of the past; and the competition went through the whole length and range of the silk manufactures, and there was not a single article now made in Spitalfields but could be increased by the use of cotton, *if France allowed the British article to enter upon the same terms as we admitted the goods of France*." Producing several splendid specimens of work turned out by the weavers of Spitalfields, he said that, "in face of fair competition with France there would still remain a fairly large industry left to the British weaver. When our manufacturers," he said, "employed French silk, on which, of course, they had to pay carriage, and manufactured an article of it mixed with a very small proportion of cotton, and sent the article to France, a duty of 15 per cent was placed by that country upon it. Competition and fashion compelled them to use more cotton than silk, and because of that they were charged 25 per cent upon their productions. Every manufactured article with silk dominant was charged 15 per cent, and every article with cotton dominant was charged 25 per cent duty."

The fact, of which the above extract from Mr. Buckingham's statement is but a single illustration, that none of the continental nations, nor America, will enter into free and equal competition with many of our manufactured goods, but require their own manufactures to be protected from ours by levying on our goods heavy import duties, cannot be left out of view in proposing or considering improved systems of technical education for our own artisans. Other countries admit they cannot compete with us on equal terms, either

as regards quality or price, with most articles we manufacture; and it must be borne in mind that we have placed their manufacturers on perfect equality with our own, by allowing them to have, duty free, our raw materials (as coal) and our unfashioned materials (as crude iron), which they, like ourselves, fashion by means of high class labour, into articles which enter our country free of duty, whilst ours are excluded, or all but excluded, from theirs by heavy import duties. It is sometimes alleged, by those who take an unfavourable view of the skill of our craftsmen, that not a little of the excellence of some of our productions is due to foreigners being the managers of these industries. But if the apprenticeship schools are making the foreign artizan superior to our own in every form of handwork, then the goods produced, whether as regards quality or price, by the combination of foreign workmen and foreign managers, ought to surpass those produced by a combination of our own artizans and foreign managers, especially as foreign manufacturers have free access to our raw materials, and have the command of cheaper labour.

It must be evident, at least to those who have given thought and attention to education, and to British and foreign manufactures, that the establishing of technical workshop schools in this country, similar to those established on the Continent, is not likely to be the best or correct plan for improving the technical education of our own artizans. They are superior to the foreign artizan in many kinds of technical skill; they require, therefore, an instruction suitable to their needs, as the artizans of foreign countries require one suitable for the conditions they are placed in. But if anything practical is to follow from the Reports of the Royal Commission, the scheme or plan proposed and the machinery for carrying it out will require very careful consideration. If the plan proposed is a mere copy, it will most likely fail; it is essential, in framing a scheme most suitable for English workmen, to consider the advantages they possess, as well as the disadvantages they labour under, compared with foreign artizans in acquiring technical skill; and the differences in mental aptitude displayed by the two classes ought also to be taken into account in its construction.

VII. THOUGHTS ON MY NEWLY-COMPLETED TABLE OF EARTHQUAKE COMMOTION AND SUN SPOTS.

By A. H. SWINTON.

WHO that has been brought up in wholesome dread of the three books of Euclid, logarithms of China, and two calculi of our Gallic neighbours, but experiences a most dreadful qualm when an astronomical topic is mooted. And truly the present state of physical science, as displayed by a good text-book on the subject, is by no means cheery or inviting to a naturalist. As in ancient days an attempt to solve the apparent motions of the heavens ended in a Gordian tangle of spheres, circles, and triangles, so I am much afraid now-a-days nature bids fair to be eclipsed under a blur of conic sections, values of the function of x, long columns of figures, and a most terrible nightmare of micrometers, frightful to our eyes as was that picture of the torture of the wicked in a burning sun, that nightly awoke before the old monk's conscience in the arcanum of his mediæval crib.

Indeed, this spring, when I wrote, unwittingly and in the form of conjecture, a partially correct statement of the connexion that exists between the periods of seismic disturbance and the sun spot periods, to the editor of the "Daily News," I had then not the slightest idea that some weeks thence, I should find the whole of this much perplexed subject resolving itself back into that beautiful image of natural harmony and proportion that every lover of science kindles at the sight of.

No surer does the shadow on the wall, or hand on the dial-plate, mark in turn the time-honoured numerals of the Romans than do these black spots on our sun's disc indicate the periods when the face of the globe is to be convulsed by the cycle of volcanic eruptions and earthquake tremors. Maximum and minimum, minimum and maximum, they recur, back to the time when Columbus opened up the great physical history of a New World.

From this date, indeed, we first really see the round world as it actually is, and gain power to generalise and tabulate these disturbances; and by so doing, we not not only find that we are enabled thereby to construct a seismic table, but we likewise gain a pretty exact idea of the sun spot wax and

wane, from those hours until the present disastrous phase, when the issue of "Whitaker's Almanack" is as black with earthquake phenomena as the sun has been dim with maculæ.

Why, then, we may now ask, Is the moon pitted over with huge volcanic mountains? And the answer is plain. Simply because more exposed it is baked and frozen in turn until its bronzed surface has become all cicatrised over from the alternate contraction and expansion of its soil, and its history has become as indelibly written in sun tremors as the story of this globe is told in billowy hills and up-turned strata.

All this I learn from my seismic table. To-day I have accomplished a feat, and entered on a region imperfectly, if at all, known. I have constructed a table showing the years of maxima and minima sun spots between 1880 and 1500, with a good index to others, reaching back to the year 0. As I look upon this little history of this great earth before telescopes and rain-gauges were, I seem to see the shadow on the paper of those great laws that rule the nebulæ of suns, that hang out on dark space like mackerel clouds in the evening stillness. But the matter in detail is prosaic. During the period in which I have indicated the work of chronicling as the more feasible, I discover the differences intervening between the known sun phases in Wolff's table will point the periods of commotion back to 1500, and that, although I get no recurring differences accurately speaking, here and there, there come on, in a remarkable manner, certain long periods when the lapse between the maximum and minimum of spots is 10, and this, likewise, at stated intervals. 1788 to 1798, 1657 to 1667, 1521 to 1531. These dates, as far as I can determine, fairly signalise the maxima and minima points of the progressive change in the east and west variation of the magnetic needle. Otherwise, there is a great uniformity presented in the cycles. Between 1855 and 1755 the number of epochs of the maximum and minimum of spots works out as 18, between 1755 and 1655 the same, between 1655 and 1555 the same. This result, I should state, is given wholly by the breaks in the seismic tables, and I gain much confidence in my work from the circumstance of this same uniformity.

It will thus be seen that the dependence of the greater cycles of terrestrial magnetism, indicated by the east and west deviation of the compass needle, is indicated as being dependent on the shorter sun spot cycles. May it not, then, be likewise that the inclination of our globe to the sun, as

determined from the precession of the equinoxes, has likewise been enacted in great dependent cycles. If so, we might think to see the resolution of the crude Newtonian theory of gravity and squares of the distances, into a known harmonious reality—electricity; and the sun, from its late execrable conduct, would take its place then among the worst regulated of magnetic lights.

And now another matter. If earthquakes and volcanoes are in activity at the minima and maxima of sun spots, and their period coincides, as in spite of previous conviction I now own with these epochs, the phenomenon must, as I before intimated, be considered as due both to the expansion and contraction of the earth's crust, rather than to its secular contraction, as is often stated. This, also, is the only aspect of the question which is true to work upon. It might likewise appear to some that, however fair the reasoning from the known to the unknown might be, a seismic sun spot table, constructed from the data furnished by igneous commotions alone, might want checking by other and independent phenomena. Here, of course, the laborious searchers in old records are again in request, and each branch of golden sun lore has to be culled from out the dusk of the monkish cell and archives of the past. My own predisposition has been greatly for biology, and when writing my late work, "Insect Variety," I was led to recognise the fact that the multiplication of locusts in southern Europe recurred regularly at each epoch of minimum sun spots, and that their dissemination northward, and final disappearance, ensued on the arrival of the succeeding maximum season. Any way the period is always marked, and communications on this subject have been already made by me to the daily papers, the "Journal of Science" for August, 1881, and more lately to the Linnean Society. By its means, I have now succeeded in checking certainly some six minimum-maximum periods in my seismic table before the date of actual instrumental observation, and, as a fact, Köppen indicates one cycle, 1333 to 1336, far back in time when seismic records are confined to the area of the Old World alone, and I have my doubts whether anyone then really knew the existence of sun spots at all. Other checks are to be found in the deviations of the compass and in the sudden appearance of the Aurora Borealis. And even should the intrinsic value of these last records be not great on the whole, the surprise of a fine Aurora in the south of England—as, for example, those magnificent crimson flashes which broke over London on the nights of the 24th and 25th

of October, 1870—could never be disregarded as truly intimating the epoch of a maximum of sun spots.

Lastly, as all would be discoverers, I often ask myself whether a sun spot table, constructed on my plan, has been ever previously attempted. I cannot, myself, answer this question, but I find indications of the line of research are extant in Prof. Karl Fuch's "Die Vulkanischen Erscheinungen der Erde" for 1865, and in an article on the earthquake and volcanic tremors in Brazil, by M. Poëy, a writer who has done much to clear up the difficulties of connecting natural phenomena with the sun spots.

ANALYSES OF BOOKS.

Cameos from the Silver Land, or the Experiences of a Young Naturalist in the Argentine Republic. By ERNEST WILLIAM WHITE, F.Z.S. In Two Vols., Vol. I. London: Van Voorst.

EVERY one must admit that the La Plata territory, now generally called the Argentine Republic, is, practically speaking, an unexplored region. Its flora, its fauna, its climatology, and its geological and mineralogical details are almost a sealed book, which, when opened, will be well worth reading. One reservation must indeed be made: the old Spanish government of this vast and important region is known to have made a careful survey of its mineral wealth. Of this important document a single copy only is known to exist, and it is unfortunately in the hands of a person who refuses to allow its publication. A country so extensive, and so rich in unrecorded objects of interest, would furnish admirable scope for the labours and researches of a Wallace, a Belt, or a Bates, and we therefore opened the volume before us with impatience. Our hopes, based as they were upon the title of the book, have been gratified only in part. The author, though evidently a zoologist and a botanist, and though enjoying ample opportunities for observation, seems to have given his attention more to the manners and customs of the inhabitants, to the state of society in the towns, the places of amusement, the promenades, and the markets, rather than to the fauna and the flora. Turning to the table of contents we read such headings as "Jealousy of Portenos—Naturalisation—Compulsory Military Service—Papeletas—Mixed Races—Manana—Patriotism a Shibboleth—Capacity of Bonaerenses—Alta Metafisica—Physique of Bonaerenses—Padre Pulpero, Hijo Caballero—Love of Parents—Formation of Character—Morale—Smoking—The Ladies—Madame Rachel—Musical Capacity, &c.—we might almost add *usque ad nauseam*. Such subjects have, of course, their interest for many, but they are hardly what we expect to find forming the bulk of the "Experiences of a Young Naturalist." There is, however, matter much more worthy of attention. The Eucalyptus, it appears, has been introduced, and succeeds well, but we find the complaint that it "sterilizes the ground completely." We should like to learn whether a similar result has been observed in other countries, and upon what it depends? Forest trees, as a rule, do not exhaust the soil nearly so much as do field crops. The author

comments on the disastrous effects which on the La Plata, as in all semi-tropical countries, are sure to follow the eradication of the woods. Two winds are noticed which seem to render the preservation of the forests an especial necessity: the Pampero, a south-westerly tempest blowing from the Andes with great fury, and sometimes causing the thermometer to fall 20° in five minutes. The Zonda is a northern wind, hot and dry. It blows from the deserts of Atacama, and raises the temperature with wonderful rapidity. The meteorology of the country is evidently, as the author pronounces it, a very difficult study.

Mention is made of a spider, *Epeira socialis*, which spins a "beautiful cocoon of orange-coloured silk suitable for working." This material has already found practical application. From the specific name *socialis* we should suspect that this spider is less given to internecine strife than most of its kindred.

The province of Mendoza contains an immense supply of petroleum, of fine quality, so that South America need not long be dependent upon the United States for a supply of this requisite. The province of Salta is rich in the cebil, a species of acacia, whose bark contains 20 per cent. of tannin. Unfortunately it is gathered by the profligate system of stripping the bark only as high as a man can reach, and leaving the trees to die. The natives of Patagonia, whom the author calls "huge macropods," are described as having enormous busts, whilst their lower limbs do not correspond to the bulk of the trunk. The whole plain of the Pampas is said to be "sprinkled thick with fossils," of which, however, no further notice is taken. We should think it possible that a careful observer might meet with important novelties.

A blood-sucking fly, the "Mosca brava" (*Stomoxys calcitrans*), is a great obstacle to the multiplication of horses and cattle in the Gran Chaco. As this species is found in England its range must be very wide. The quebracho wood (*Loxopterygium Lorentzii*) is said to be an excellent timber for sleepers, shipbuilding, &c., lasting twice as long as oak. On page 62 we find a curious passage. Concerning the province Misiones we read:—"The *sensual* delights which arise from hills and mountains, dales, plains, and valleys, forests and meadows, a fruitful soil and a deliciously balmy climate are here presented with a liberal hand." We should scarcely call such delights "sensual."

On page 109 we meet with a general survey of the Argentine fauna as met with in country districts. Among the predominant butterflies the author mentions fritillaries, *Colias Lesbia*, *Callydrias*, *Danaus Archippus*, and *Vanessa Io*, which, like others of its group, is almost cosmopolitan. On the river banks are found more tropical forms, such as *Papilio Thoantides*, *P. Perrhœbus*, *P. Lycophron*, species of *Euryades*, *Heliconia*, *Morpho*, &c. A leaf-cutting ant is very destructive to all vegetation not indigenous. Very offensive is the Pampa Bug (*Conorhinus infes-*

tans), a flat chocolate-coloured wretch which haunts the ceilings of bed-rooms, and lets itself drop upon the sleeper. In the morning it is found on the walls "no longer a flat disc but a globular bloated mass." One of the many species of mosquitoes —not named—gives out a delicious fragrance, especially if crushed. The Museum of Buenos Ayres is said to be richer than any other in "palæologic edentate osteology." The author exclaims, "The gigantic Megatherium, or his ancient brother the Mylodon, with what a derisive smile must they view the efforts of their feeble modern vicar (!) the *Bradypus tridactylus*." The museum is under the direction of the illustrious entomologist Dr. Hermann Burmeister. On the subject of rabies, said to be rare in La Plata, the author says:—"As for the dogs the breed is so inferior as not to subject them ordinarily to a disease so aristocratic, which, like the gout in man, only attacks good blood." The Pariah dogs of India, which can scarcely boast of aristocratic lineage, are by no means free from rabies. On page 239 the author goes out of his way to indulge in an attack on cremation and on sanitary chemists. He makes the curious remark that the "custom was all very well for Pagans with little or no notion of the dignity of the human body." The vexed question as to whether vultures find their prey by sight or scent seems to be decided in favour of the former as far as the Condor is concerned. One of these birds, when hungry, took no notice of a lump of meat wrapped up in a single fold of a newspaper. The author considers that there are two species of Condor, a black and a brown.

The author's style is, according to our taste, not sufficiently quiet for a scientific work. We have already noticed some curious expressions, and might select many more. Thus we read of the "cadenic summit" of a mountain, of "Longobardi centaurs," of "Stygian-laden gulleys," a "liquescent water-pear." An eagle is described as sitting upon a pinnacle "ready to swoop upon any unfortunate stray psittac." We are almost reminded of the Limousin student who, for indulging in "tall talk," was evil-entreated by Pantagruel. We may venture to express the hope that the second volume may be richer in scientific facts and written in plainer language.

On Exercise: an Address Delivered on the Anniversary of the Military Medical Culture Institutions on August 2nd*, 1881. By Emil du Bois Reymond. Berlin: August Hirschwald.

Pooh! a treatise on gymnastics, of importance, perhaps, to acrobats and tumblers! Not so, lessons of grave importance,

* Ueber die Uebung. Rede gehalten zur Feier des Stiftungstages der Militair-Aerztlichen Bildungsanstalten.

not merely to the medical profession but to the individual man and woman in whatever position in life, to the sanitary reformer, and to the statesman, unless he be wilfully blind. We say to the sanitary reformer, for the mere absence of zymotic disease is a very little gain if a nation is at the same time sinking more widely and deeply into a state of general debility. Prof. Du Bois Reymond, with all the authority due to his high and well-earned reputation, enforces before a gathering of the physicians and surgeons of the German army the weighty truth that every organ of the animal body must be duly exercised if it is to reach a maximum stage of perfectation, or if it is even to remain in a moderately healthy condition. It may, of course, be asked what need is there for so eminent a man to teach so elementary a lesson? We reply, because, elementary as it may be, this truth is not practically incorporated in our habits of thought, and in our daily lives. The vicious old notion that the ordinary sequence of cause and effect does not extend to man haunts us yet. Further, physical debility has been carefully cultivated at the dictates of superstition. The abolition of the cleanliness and the bodily exercises of classical antiquity, and the introduction of fasting, have enfeebled the human race to an extent difficult to conceive. It is sad to think that to this day, in the south of Europe, personal cleanliness involves the suspicion of a leaning to Mohammedanism. In the feudal ages athletic exercises, indeed, revived, but, as far as England is concerned, they were greatly checked by the advent of Puritanism. In our own time physical culture has to meet two enemies; the industrial organisation of modern society is unwilling to leave us either time or energy for the exercise of any faculty of the system not directly applied to commerce, and seems to fear that if we are physically vigorous we may feel tempted to revert to the military *régime*.

There is another agency which, so far as the female sex is concerned, militates powerfully against a healthy bodily development. We mean the absurd notion that health, in all its manifestations, is coarse and vulgar, whilst indigestion, nervous debility, and the manifest signs of a phthisical, or a scrofulous tendency, are "interesting," refined, and high-bred! Ignorant nurses, governesses, heads of schools, and even mothers, cherish this eror to an extent perfectly disgusting. It would be hard to enumerate the evils which have been occasioned by the modern corrupted use of the term "delicate." Its original meaning has not the least reference to sickliness or feebleness. Much might be gained if our physicians would cease mis-using the word themselves, and protest against its misuse by others.

Summing up all these considerations we must admit that there is still need for men of standing to plead the cause of a thorough physical training.

But Prof. Du Bois Reymond calls attention to a point usually overlooked by the lay public, by drill masters, teachers of athletics,

and even by no small portion of the faculty. The so-called muscular exercises are in reality something more; they are at the same time exercises of the central nervous system, of those portions of the brain and the spinal marrow upon which the action of the muscles of voluntary motion depends. It is by this exercise of the nervous system that the co-ordination of the action of the muscles is taught. Few exertions of strength and skill depend upon the contraction of a single muscle. Even in such a comparatively simple case as a leap a number of muscles must act in due proportion and succession. In default of such co-ordination the force of any, or of all of them, is of little avail.

Nor must the exercise of the senses be forgotten, a matter quite overlooked in our ordinary systems of education. Who thinks of training a child to a nice discrimination of form, colour, texture, hardness, and other properties of objects as they appear to our senses? Nor will this ever be done till words, the "money of fools," are thrust into the second rank whilst things are exalted into the first. Training as distinct from information, method as opposed to doctrine require little aid from books.

Into the author's suggestive reflections on the interaction of heredity and exercise, and on the part played by the latter in phylogeny, space does not allow us to enter.

Coming to the practical portion of his address Prof. Du Bois Reymond compares the two systems of gymnastics, the Swedish and the German, and the athletic sports which in England serve as a means of physical culture. The Swedish system he condemns as suitable merely for medical purposes, where it is needful to maintain or increase the activity of particular groups of muscles. "It can strengthen the muscles, but it does not confer expertness in compound movements." We may, however, well question whether the author is fully acquainted with the latest development of the Swedish system by Dr. *Z*ander, as it may be seen at the medical gymnastic establishment in Soho Square. We were most favourably impressed with its value, not merely in the treatment of certain diseased conditions, both internal and external, but as a means of physical culture for the sedentary population of our towns. The German system includes the use of the dumb-bells (Hanteln). But must it not be admitted as an advantage if the weight of the dumb-bells used could be insensibly increased every few days as the muscles of the tyro become developed? Now the Swedish system enables, *e.g.*, movements performed by the same groups of muscles as the dumb-bell exercise to be rendered progressively more difficult by imperceptible stages. We think that Dr. *Z*ander's institution is well worth an attentive examination. Every anatomist must at least be delighted to note the mechanical skill shown in calling into play the various groups of muscles.

As regards the athletic sports of England, such as rowing, hunting, cricket, foot-ball, &c., Prof. Du Bois Reymond is far

from denying their value. He concedes that they lead even more directly than the German gymnastics to the power of executing compound movements. Still, he considers that the selection of exercises to which long experience has led in Germany ensures a greater and more thorough equability of bodily development. Just as a well-trained mathematician is provided with methods for every conceivable problem so the German athlete can easily accommodate himself to every required phase of bodily exertion.

He glances at another advantage of the German system. It requires less space, less expense, fewer outward appliances, and may be pursued everywhere by any given number of pupils of any age or condition, whilst English sports require for the most part large open spaces. The author might have added that though well adapted for country gentlemen, for yeomen, farmers, and for the general population of villages and small towns, they utterly fail to reach the bulk of the dwellers in our great cities. But as the city population is increasing, and the country population is decreasing, it follows that a relatively smaller and smaller portion of the nation partakes of any bodily culture. In the commercial classes physical inferiority is signally manifest. It is painful to reflect that the proposal to submit the boys in our Board Schools to a course of military drill is vehemently opposed by a certain faction. The volunteer movement, which gives a slight modicum of physical training to at least a fraction of our town population has been opposed from the same quarter. At the risk of possible execration we will venture to say that apart from all political considerations, which lie quite outside our competence, compulsory military service would prove an inconceivable boon to this nation. The improvement in the *physique* of the Germans, even within the memory of persons now living, is startling, and must give them an advantage which is far from being confined to military affairs.

Chronicles of the Photographs of Spiritual Beings and Phenomena Invisible to the Material Eye: Interblended with Personal Narrative. By Miss Houghton, Author of "Evenings at Home in Spiritual Séance." London: E. W. Allen.

We have here a work not easy to criticise. The authoress, who is evidently a sincere believer in what she narrates, teaches us that under certain conditions, if the photograph of a living person

is taken in the usual manner, on developing the plate there appear occasionally other forms in addition to that of the sitter. These forms are often recognised as the similitudes of deceased friends or relatives. The conditions of these singular phenomena are not definitely enumerated in Miss Houghton's book. As far as we gather from various passages the presence of a medium is essential, but it does not appear necessary that the sitter should possess mediumistic powers. It is also requisite that the sitter should be in a calm, unruffled frame of mind. Even when these conditions are carefully fulfilled success is by no means uniform, or rather, it is decidedly exceptional. The additional figures appear generally draped in wide, flowing robes, like the white-sheeted ghosts of ancestral tradition, but the head and face, according to the specimens given in illustration, are often clearly and distinctly human, and might admit of recognition. In some cases the entire figure is reproduced with but scanty drapery, and sometimes a trunk has appeared without a head. Persons not endowed with mediumistic power see on such occasions nothing save the sitter and the furniture of the room. We have, then, the hypothesis that objects may exist which reflect only light capable of acting upon a prepared plate, but invisible to the human eye. That there are such rays of light, the so-called ultra-violet rays, is admitted. The human eye is only susceptible to a certain part of the spectrum. The ultra-violet rays, further, are able to set up chemical action of various kinds. But the novelty here involved is the supposition that objects exist which reflect such rays, and such only. We have no right to pronounce, *à priori*, that no such objects are possible. But we are here brought in contact with one of the limits of our perceptions. Whatever does not reflect rays of light which affect our retina is for us simply invisible, and, for anything we can show to the contrary, there *may* be such objects. Questions here naturally arise which can only be decided by varied and prolonged photographic experimentation.

The genuine character of the figures obtained is, of course, liable to be questioned, or rather denied. Having never come in contact with jugglers, or studied their modes of action, we are not entitled to say with authority what is within and what is beyond their power. But a very considerable number of precautions for the prevention or discovery of fraud have been adopted. The cameras have been carefully examined and exchanged for others. Private marks have been put upon glass plates brought to be operated upon lest they should be exchanged for others previously prepared whilst in the dark room. The entire studio has been searched, as we understand, not merely by amateurs but by experienced practical photographers, but the "trick," if trick it be, has not come to light. We read:—"Neither Mr. Hudson nor Mr. Herne knew who we were. Mr. Herne I never saw before. I shut him up in the recess at the back of the

studio, and secured the door on the outside, so that he did not—and could not—appear on the scene. Mr. B. Coleman, who was with us, and myself (*i.e.*, Mr. Howitt), took the plates at hap-hazard from a dusty heap of such; and Mr. Coleman went into the dark chamber with the photographer, and took every precaution that no tricks were played there."

Another writer here quoted justly remarks:—"No photographer can counterfeit the portrait of a deceased person unknown to him, and of whom no likeness exists. Yet this is what is done in Mr. Hudson's studio." Mr. Beattie (a retired photographer) maintains that the luminous appearances seen by sensitives as issuing from magnets, crystals, &c., as in Baron Reichenbach's experiments, when condensed, affect prepared plates as energetically as does solar light. As regards the tests proposed Miss Houghton remarks *naïvely* that "Scientific men are very exacting, and have no kind of compunction as to the labour and fatigue that their fancies may entail." She should remember that they spare no labour or fatigue in testing their own results.

The importance of testing these results to the uttermost cannot be gainsaid. A person may think he sees something non-existent. Several persons may fall into the same delusion. But we hold even the author of the phrase must admit that a photographic plate cannot be swayed by a "DOMINANT IDEA."

Miss Houghton's book is inconveniently arranged. We do not find certain principles distinctly laid down and proved *seriatim* by experimental evidence. The plan of the book is historical with much repetition. Hence prolonged reading is required to sift out the phenomena alleged to have been witnessed from matter of a subjective nature. We trust, however, that we have not misinterpreted the author's views.

Physics of the Earth's Crust. By the Rev. OSMOND FISHER, M.A., F.G.S. London: Macmillan and Co.

WE have here an important work by a valued contributor to the "Journal of Science." The author has undertaken to answer certain problems in physical geology, "negatively, if not positively," by the application of simple mathematical reasoning and quantitative treatment, and the results obtained, though admittedly approximate, are not merely of interest in themselves, but are calculated to draw further attention to the method, which has been here pursued. It must not be supposed, that the questions here raised concern merely the physicist, the astronomer, or the geologist. An attempt has been made by an eminent

authority, to fix a maximum limit for the time which has elapsed from the solidification of the earths' surface down to the present day. The results reached, though based upon an imposing array of figures and formulæ, vary from 33 to 300 million years, or in the proportion of 1 : 10! Surely such discrepancies might have suggested reasonable doubts as to the value of the whole investigation. Yet, on the faith of calculations so discordant a kind of flank attack has been made upon the teachings of geology, and to a certain extent upon the doctrine of Organic Evolution. Thus Prof. Tait says:—"Geology, in framing its conclusions, is compelled to take into account the teachings of other sciences. If we feel disposed to give an indefinite amount of time to the evolution of cosmos out of chaos, the student of heat and mechanics comes in and asserts upon the authority of his branch of science, that a limit must be put to the time available for bringing about the present condition of things: he will grant 100 to 300 millions of years as the extreme allowance of time; if geologists cannot be content with this allowance, so much the worse for the geologists, for more they cannot have." Now it may be possible and is indeed probable, that the mutations in organic life have not proceeded at one uniform rate. It may also be possible, that the high tides due to the former closer proximity of the moon (See "Journal of Science," 1882, p. 43) may have effected denudations at a much more rapid rate than is now going on, and consequently that geological changes may have been effected in comparatively short times. Still the majority, both of geologists and biologists feel bound to reject Sir W. Thomson's results, as based upon arbitrary and unproved assumptions. Among these suppositions are:—That the earth, though once fluid is now a solid, cooling by conduction; that the temperature of the earth's crust increases as we penetrate deeper, but at a gradually decreasing rate; which, at about 5000 feet below the surface, becomes *nil*. That the molten matter ejected by volcanic action is "derived" from the transformed work of crushing the rocks of the earth's crust, owing to the contraction of its interior through long-sustained cooling.

These assumptions, Mr. Fisher traverses very ably, and, in our opinion, additional weight is due to his arguments, because they are brought forward without any regard to the requirements either of geologists or biologists. In his first chapter, he discusses the experiments which seem to indicate that the rise of temperature on boring deeper into the earth proceeds at a gradually decreasing rate, and points out several circumstances by which the results are rendered doubtful. His conclusion is, that "we know nothing by observation, respecting the law of increase of temperature within the earth, beyond the facts, that near the surface the average rate of increase is 1° F. for between 50 and 60 feet of descent, and that the temperature at greater but unknown depths is very high, sufficient to fuse what, from that very cause, we term igneous rocks."

Sir W. Thomson's assumption of the total solidity of the earth's interior rests upon grounds, none of them decisive, and two of which he has in effect given up. Supposing that the earth is, as a whole, extremely rigid, it does not follow that it is wholly rigid from centre to circumference. If further, the elevations on the earth's surface are due to the contraction of a hot solid globe, cooling by conduction to and radiation from the surface, the average height of the elevations above the datum level can be calculated to a few feet. If we suppose that the temperature near the surface increases at the rate of 1° F. per 51 feet, and that the rocks have been solidified at the temperature of 7000° F. (an extreme supposition), the average height of the elevations from the era of solidification down to the present time would be only between 800 to 900 feet. If we take 4000° F. (the temperature of melting slag) as the more probable point of solidification, the average elevation will be below 200 feet. But even the highest of these assumptions is wide of the truth. The average height of the elevation of the earth's surface above datum level is at the lowest estimate 9500 feet. Consequently, Sir W. Thomson's assumption of a wholly solid earth, fails as leading to results glaringly at issue with facts, and his calculations based upon such assumption may be safely pronounced null and void.

The following remark, though directly connected with the present argument, is also important in reference to the constancy of the distribution of land and water:—"The islands of New Zealand occupy a central position in the aqueous hemisphere, and yet they contain a series of deposits chronologically analogous to those of the northern hemisphere; whence it follows that they must often have been submerged during periods, when there existed, in what is now an extended ocean-land, surfaces from which the materials of their rocks must have been derived. The sinking of river-plains and estuaries, a phenomenon of general occurrence, is also significant. The author observes, what is required to explain such facts is a liquid or at least a plastic substratum for the earth's crust to rest upon. In connection with the supposed permanent position of continents and oceans from the earliest times, Mr. Fisher doubts whether the doctrine is fully proved.* It is suggested that a large portion of the ocean now above the earth's crust may have once been below it, and thus we gain a novel conception of a sense in which the fountains of the abyss may once have been broken up.

Passing over much important matter, we come to the author's examination of Mr. Mallet's explanation of subterranean heat, as manifested in volcanic action, in hot springs, and in the high temperature of deep mines. That heat he considers as "pro-

* See Quart. Journal Geolog. Soc., xxxvi., p. 351, and Geol. Mag., Decade II., vol. vi., p. 385.

duced locally within the solid shell of our globe by transformation of the mechanical work of compression, or of crushing of portions of that shell, which compressions and crushings are themselves produced by the more rapid contraction by cooling of the hotter material of the nucleus beneath that shell." This theory is of the more importance, because, if we admit the hypothesis of a globe solid throughout, scarcely any other method to account for volcanic phenomena remains. The refutation of Mr. Mallet's theory contributes, therefore, powerfully to overturn the assumption of the earth's solidity, and, in consequence, Sir W. Thomson's limits to the duration of our globe.

The first objection which Mr. Fisher brings forward, and which to us seems fatal, is that volcanic action is of daily occurrence, whilst it is unproven and strongly doubtful that such contractions have been constantly going on within historical times. Further, in Mr. Mallet's statements, there is a serious discrepancy. In the "Philosophical Transactions" he argues that the heat developed from crushing ten volumes of rock would melt about one, whilst in his translation of Palmieri's "Vesuvius" he estimates that the crushing of one cubic foot should melt $3\frac{1}{2}$ cubic feet, or more than 32 times as much as his former conclusion. It may certainly be said, that if this latter value is correct, the cubes of rock upon which he experimented ought to have been melted, which was not the case. There is another absolutely fatal objection. Suppose, taking the lower estimate, that the heat developed in crushing ten cubic miles of rock would be sufficient to fuse one cubic mile, if it could be all concentrated upon that one; it is still altogether unreasonable to suppose that such concentration can take place. As Mr. Fisher puts it:—"Unless the heat got out of crushing any portion of rock is sufficient to fuse that particular portion, none will be fused."

The chemical theory of volcanic action put forth by Davy is now generally abandoned. Were water decomposed in the interior of the earth by contact with the alkaline metals, torrents of hydrogen gas would be given out, and true flame would be a marked feature in every volcanic eruption. It is scarcely necessary to say that such is not the case.

Want of space compels us to bring our survey of this work to an abrupt close. It is one which may be recommended to young geologists and physicists, as not merely instructive but suggestive, and as calculated to lead to a revision of certain accepted theories. The considerations here brought forward, joined to other evidence, may lead judicious inquirers without at all relapsing into the coarse catastrophism of Cuvier, to doubt whether the opposite doctrine of uniformitarianism has not been carried too far.

Violationism; or Sorcery in Science. By MRS. ALGERNON KINGSFORD, M.D. In "Light," for Feb. 4th, 1882.

OUR readers will doubtless be perplexed with the term "violationism." To save them the trouble of a vain search in the dictionary, we may at once say, that it is a cant name for experimentation on animals, invented by a leading anti-vivisectionist.

Mrs. Kingsford, who it appears, is one of the female M.D.'s of the present day, has taken it for the title of an ultra-sensational attack upon physiologists, whom, in a very far-fetched manner, she likens to the sorcerers of old. A few such sorcerers, it appears, used occasionally to torment animals in order to propitiate evil spirits. Hence, in the opinion of our worthy doctress, they stand on the same level as our modern vivisectors, from Harvey downwards! This attempted identification of science with sorcery is, we presume, the retort courteous for the comparisons which have been made between spiritualists and necromancers. The good lady waxes very wroth, and gives us a few of the most sensational cases of vivisection she has been able to collect, doubtless willing that her hearers should consider this a fair representation of experiments upon animals. She carefully avoids encountering the fundamental principlewhich we have so often put forward, viz., that if it be justifiable to inflict pain and death upon animals for "sport," for food, for furs, and other products, for personal safety and comfort, and to force them against their will and convenience to serve us, it is at least equally permissible to inflict pain and death in pursuit of knowledge. The person who shrieks against vivisection, and who yet partakes of animal food, wears furs or feathers, employs horses for riding or travelling, &c., may not be a conscious hypocrite, but he is at least guilty of gross inconsistency. We profoundly regret that the "British National Association of Spiritualists" has allowed this lecture to be delivered at one of its regular meetings. By so doing, it has formally declared war against biologists of all grades, making no distinction between those who regard Spiritualism as jugglery and imposture, and those who, to say the least, considered it entitled to a candid hearing, and hoped that some of its claims might be substantiated.

How to Use the Bromides. By GEORGE M. BEARD, A.M., M.D. (Reprinted from the "Journal of Nervous and Mental Disease," Vol. VIII., No. 3, July, 1881.)

THIS pamphlet is the substance of a paper read by the author before the American Neurological Association on the medical uses of the metallic bromides. The value of these compounds,

especially the sodium bromide for the prevention of sea-sickness, is well known, but the author insists upon the administration of large doses, say of from 30 to 100 grains, if the effect is to be secured. He gives also the caution that when the tendency to sea-sickness appears overcome the doses should not be continued. Sleepiness by day, loss of sensitiveness in the fauces, are, the author finds, indications to discontinue the treatment.

Dr. Beard, in the course of his experiments on the Maine "jumpers," gave large doses of the potassium salt to one of his subjects, but without any beneficial results as far as the jumping was concerned. Concerning this case Dr. Beard makes the following curious remark:—"I did not know how much I gave him, but this I do know that I would never give the same quantity to anyone again under any circumstances."

The Insect Hunter's Companion: Instructions for Collecting Butterflies, Moths, Beetles, Bees, Flies, &c. By the Rev. Joseph Greene, M.A. Third edition, revised and extended. London: W. Swan Sonnenschein and Allen.

We have here an enlarged and improved edition of a manual which has been found useful by many entomologists. The editor, Mr. A. B. Farn, in his preface, brings forward an argument for the study of insects, which will be intelligible even to the meanest capacity—the fact that many of the deadliest foes to agriculture are to be found among these apparently contemptible creatures. Fully agreeing with him as regards the importance of a thorough knowledge of these enemies, we can scarcely pronounce any economic results "the grandest end" to be sought for in the pursuit of entomology. We should look upon the study of insects as a field where the problems of the origin and distribution of animal life may be attacked with advantage.

The instructions here given for obtaining specimens of insects in their various stages of existence, and for rearing larvæ, &c., are sound and practical. The chief deficiency which we note is that the author takes a too exclusively "British" point of view. Surely, in these days of travelling and emigration, there is no occasion to assume that even the tyro must confine himself to the meagre insect fauna of the United Kingdom. A few methods of baiting for insects might have been advantageously added for the benefit of such insect hunters as may be disposed to try their fortune in where insects are more abundant. Thus, a white cloth spread out in a garden is a great temptation to insects of almost all orders, and a double crop will often be found upon it and below. A hole bored with a large gimblet in the trunk of a tree, so as to set the sap flowing, is a very successful bait, espe-

cially in warm climates, and is particularly attractive to high-flying Lepidoptera. The author mentions rotten apples as enticing; he might safely have said "fruits in general," the preference being perhaps due to very stale bananas where they are procurable. Many species will even settle upon any small putrid animal, and also upon recent human excrement, a sad comment upon the refined tastes generally ascribed to butterflies.

The instructions for collecting Coleoptera are from the able pen of our late friend Edward Newman, but as for the "neglected orders," they are, save the Hymenoptera, completely ignored.

On the subject of setting specimens we differ from the author, and prefer the Continental plan to the English, for the following very substantial reason: If the specimens are fixed high on the pins, and with the wings flat, the access of mites and other depredators is very much impeded if not altogether cut off.

The remarks on the question of exchanging specimens are much to the point. Something might, however, have been said on the absurd value attached to "British" specimens as compared with such of the same species captured abroad. We find nothing similar to this whim in any other country. The annoyance which the collector often experiences from the outside public are described in a manner the accuracy of which we can vouch for, though we were never insulted in the manner described by Mr. Newman in his chapter on Coleoptera.

The book may be safely recommended as a manual for young collectors, and will save them much loss of time and disappointment.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

"DISUNION IN THE CAMP."

MR. T. M. DOLAN'S able letter in our last issue requires a few remarks on our part.

We denied, and we still deny, the existence of a class of persons who would torture animals under pretence of research. We can find no signs of such a class. The Secretary of the Society for the Prevention of Cruelty to Animals, in his evidence before the Commissioners, admitted that he knew of no instances of wanton cruelty. Dr. Simon, in his Address as quoted by our correspondent, speaks of this class as "imaginary." Knowing how unscrupulous and adroit our enemies are in perverting the public utterances of medical and other scientific men, we cannot help feeling that Mr. T. M. Dolan's words will be used as an admission that such persons really exist.

As regards our respective "methods of warfare," we doubt if any kind of language will have an effect upon the leaders of the anti-scientific movement. But if we can expose their sophisms, and show their want of truthfulness and their inconsistency, we may act upon those who have been duped. As far as our memory serves us, the most successful agitations have been characterised by a very liberal use of language much stronger than we have been in the habit of employing. The tactics of the "Anti-Vivisectionists" themselves have mainly consisted in continually "throwing dirt," in the hope that some of it might stick.

Mr. T. M. Dolan holds that a repeal of the Vivisection Act, *in toto*, is, in the present temper of English society, an impossibility. We grant this proposition. But the *present temper* has been produced by agitation,—thanks in great part to the supineness of scientific men,—and by agitation it may be modified. We would, indeed, accept the "Lancet" programme for the time being, but only as a temporary instalment. In the meantime we think exception may be fairly taken to a certain point in the passage from the "Lancet," as quoted by our correspondent;—"We do claim that skilled experimenters—physiologists, patholo-

gists, and pharmacologists—shall have perfect freedom to conduct experiments on living animals, *where such are necessary to the elucidation of the problems of health, disease, and therapeutics.*" We beg to call especial attention to the words we have italicised: they seem to us far too narrow. We doubt if, *e.g.*, they would include the initial experiments of Galvani, the interesting researches of Madame Chauvin, and, generally speaking, all investigations on the causes which may influence the development of species.* Again, why are the words "physiologists, pathologists, and pharmacologists," used instead of the briefer and more comprehensive terms "biologists and chemists"?

We fear that, so long as certificates are necessary, competent men, if they have not the art of pushing themselves into notice, or if they have failed to do homage to some dominant clique, will find themselves excluded. We are glad to learn that Mr. T. M. Dolan does not propose to make a separate peace with the enemy to the exclusion of non-medical biologists, and we beg to tender our apologies for having misunderstood him. This is a point on which we feel the more jealous as we see plainly that it is one of the objects of the anti-vivisectionists to spread discord among men of Science.

We think we may lay claim to some little insight into the question. In 1876, when some of our contemporaries anticipated that the proposed Vivisection Act would satisfy the enemy, we ventured to express a very different opinion ("Journal of Science," 1876, p. 333), and in the same journal for 1878 (p. 651) we recommended the organisation of a Biological Research Defence League as a pressing necessity. Our suggestion was ignored, and the matter has gone from bad to worse. As "*servus servorum Scientiæ*" we are willing to co-operate with everyone in defeating the deplorable attacks made upon research; but so long as we do not organise we are as a scattered mob contending with a fully equipped, and, we must crave permission to say, "a fanatical" army.

THE EDITOR.

* It is not generally known that to feed an animal on unusual food, to expose it to a moister or drier air, or to a greater or less degree of atmospheric pressure, might possibly be construed as a "painful experiment," and subject the experimentalist to heavy penalties.

TIDAL THEORY OF GEOLOGICAL DENUDATION.

To the Editor of the Journal of Science.

SIR,—Some interest has lately been created by ingenious speculations regarding the *Moon's action* on the waters of the Earth in past ages, and especially in the creation of geological changes on the surface.

The theory proposes to establish *gigantic tides* in the terrestrial oceans, upheaved by a closer approximation of the Moon, in its orbit, to the Earth, thus increasing its attractive power.

It is believed there would be created a tremendous force of *current* acting as a powerful denuding agent on the superficial formations exposed to its action.

I am inclined to think that some illusion gilds this *attractive idea*, which looks well on paper to the physicist, but can hardly be so confidently accepted by the geologist.

In the first place, the moon's action creates *no currents* in the open sea, the open tide being merely a temporary elevation of the sea-level at points where the moon is passing across its surface, and of course it can create no tides on the dry land, where there is no water. The water in the wave of oscillation up and down does *not follow* the moon at all, but, as soon as the moon has passed that spot, sinks down again.

The tidal wave flows and ebbs in enclosed channels, and seas do not denude the bounding lands into hills and valleys, but level them flat into *sand-banks* and mud-flats.

The rise and fall of 648 feet of the tides would be impracticable to measure, as they could only take place in the open ocean in sufficient depth of water, and would be impossible to realise in our narrow and shallow seas.

In the case of tidal waves of oscillation there is but little analogy with *storm waves*, as the forces elevating the tidal are perpendicular to the surface of the sea, whereas in the latter they are horizontal. The impact of their *momenta* would correspond in direction, the tidal one taking a perpendicular line with lateral offset, and the storm one taking a horizontal direction with perpendicular subsidence.

In the open ocean, if it could be gauged, a tidal rise and fall of 648 feet would take place *gently and gradually*, and slowly, and round the coasts the tidal flow and ebb would only be as high as the *depth* of water there would permit. A wave of water cannot be conceived to travel over land like a gale or *dust storm*, as it would collapse at once when brought into shallows of its own depth from the open sea.

Most of the *denudation* we see on dry land has not been effected by the sea, but by fresh waters in some form, as ice and

snow were once more abundantly formed, or else instead there were violent storms, and rains occurring more frequently. The denuding *action of the tides* of our time is very mild indeed compared with that of deluges of rains in the interior of a continent, making rivers, and scooping out valleys.—I am, &c.,

FESTINA LENTE.

MAN: ADAM.

To the Editor of the Journal of Science.

SIR,—In Colenso's great work, the "Examination of the Pentateuch" (People's Edition, § 1052), after quoting from Prof. Owen's Address in Leeds, 1858 (wherein he shows the localisation of certain species from geological ages), Colenso proceeds to apply this to man "from the first differing as species. In that case it would be no longer necessary to believe that the Bushman, Australian Savage, and Andaman Islander are only *degraded* descendants of Adam or Noah, and that European, Chinese, Negro, and North-American Indian are all derived from one pair of ancestors." Then, like Gautama's dewdrop, he slips into his ocean of Geology—perhaps carried to an extreme sometimes.

Surely, in this age of evolutionists, it is more agreeable to the mind to conceive mankind as derived from one common ancestor? The simplest explanation is most acceptable. Is not the very diversity that troubles some of us the key to the truth? It must have been hinted ere now that the different races of men are not "degraded descendants" of the first human pair, but rather evolutions from them; the first fossil head we may find being immeasurably superior to our Adam. Why are not the human race ranked. like other animals, in order of evolution? Is it not evident? The lowest *do* "go to the wall"—we have but to find the connecting-links. The absurdity of Bible chronology has long been exploded, but the prejudice still lingers, and to fix Adam's appearance is simply idiotic. It would probably be a hard feat to draw the line between the highest animal and first man. I see in this the opportunity for language to have developed itself *after* the first man, making this "gift" easier to understand in the broad distinction of animal and man. The question rests only with the geologist, the anthropologist, and the physiologist.—I am, &c.,

D. Y. C.

Ilkley, Leeds.

THE UNFITNESS OF THINGS.

To the Editor of the Journal of Science.

Sir,—Mr. W. Sowerby, writing in the "Journal of the Society of Arts," gives some amusing instances of the manner in which the harmonies of Nature are distorted by artists. Thus a water-plant (*Nelumbium*) is made to twirl and twine over trellis-work like a convolvulus, and a group of Bengal tigers are represented crouching at the foot of an Australian gum-tree. But we may see errors as palpable in the grouping of organic forms even in the British Museum. Not far from the cabinets containing the Hewitson collection of butterflies there may be seen, under a bell-glass, a group of birds mostly—if not all—neotropical, and accompanied by insects from the same region; but amidst the latter are placed some purely Oriental forms, such as *Sagra* and *Chrysochroa!* Surely a national museum should not mis-teach animal geography!—I am, &c.,

Scrutator.

NOTES.

An Amusing Instance of Journalistic Inconsistency.—One of the fiercest opponents of experimental science among the lay journals is the "Echo," a cheap evening paper, one of the fixed beliefs of which, to judge from the nature of its articles on scientific questions, is that the "Anti" view is the one most worthy of support. Hence it is a constant occurrence to find its pages ornamented with reports of meetings addressed by anti-vaccinators, anti-vivisectors, *et hoc genus omne*, while its readers are not unfrequently treated to editorials even penned in the same amiable service. It is therefore with a feeling of wondering surprise we find the "Echo" devoting nearly a third of a column to a jubilant description of the benefits to mankind produced through Pasteur's inoculation experiments on sheep and other animals. Can it be that the editor of the "Echo" has forgotten the mode of inquiry by which those results were obtained? or is it that he has become convinced of the absurdity of antagonism to progress, and is resolved to sever the connection existing between himself and the party that employs his paper as a means of promulgating "Anti" views? It should be said, however, that the "Echo" has for long consistently denounced the torture of animals under the excuse of "sport," and we are glad to welcome the appearance of a determination on its part now to uphold the legitimacy of vivisection, or rather the experiments on living animals, as it undoubtedly does, indirectly, by accepting the value of Pasteur's discoveries.—*Medical Press and Circular.*

(We must not forget that inconsistency lies at the very root of the Anti-vivisection Movement.)

The "Moniteur Scientifique Quesneville" gives some curious statements of a Parisian *ravageur* concerning human bodies floating in the river:—"I always know beforehand if it is a man or a woman. If the body has the face upwards it is a woman; if it floats on its belly, with the nose in the water, it is a man. I have remarked that a man who has been thrown into the water after being assassinated reappears on the surface much earlier than one who has fallen in by accident, or has drowned himself. The time the body remains beneath shows whether it is a case of suicide or of murder. Fishes avoid any particularly offensive discharge of matter from the mouth of the sewer, and hide themselves among the weeds till the nuisance has passed."

It would appear from "Light" that Mrs. Kingsford, M.D., who

has lately made herself conspicuous as an anti-vivisectionist writer, is a believer in metempsychosis, and suggests that man-eating tigers may be animated by the spirits of deceased cruel men, for ought we know, vivisectors!

The "Lancet" combats the fashionable view that fog is a function of smoke, which gets worse as the quantity of fuel consumed in the metropolitan area increases. It maintains that the fogs in the "thirties and forties" were as bad as those at the present day, if not worse. Friends of ours who recollect London as it was 40 or 50 years ago take the same view.

A correspondent of "La Nature," a native of Guadeloupe, confirms, from personal observation, the report that the males of *Dynastes Hercules* seize small branches of trees between their enormous "horns," and then whirl round and round till the twig is amputated. No one seems to know the exact object of the process, though it may be to set the sap flowing, which numerous insects consume eagerly.

In the Gardens of the Society of Acclimatisation at Paris there are at present two male hybrids, one between a Houdan cock and a Guinea hen, and the other between a Cochin China cock and a Turkey hen. Their morose and unsociable disposition has rendered it impossible to ascertain whether they are capable of reproduction.

Mr. H. H. Howorth ("Geological Magazine,") adduces further evidences of an extensive post-glacial flood, accompanied probably with volcanic action.

Prof. O. C. Marsh ("Geological Magazine,") gives a new arrangement of the Dinosaurians, which he views as a sub-class and divides into five orders, the Sauropoda, Stagosauria, Ornithopoda, Theropoda, and Hallopoda.

"Light" gives a very curious account of a "haunted house." One of the most remarkable phenomena recorded is, that a flame of a gas-burner, placed opposite the foot of the bed occupied by the observer, without diminishing in size, gave out for some time an unusually small quantity of light.

W. H. Edwards ("American Naturalist,") has observed, that male butterflies of the species *Heliconia charitonia*, assemble to keep watch over female pupæ of their own species.

The same author, in refutation of a statement by Mr. Scudder, shows that the females of *Argynnis myrina* have fully developed eggs when they emerge from the chrysalis.

The editors of the "American Naturalist," in reviewing Mr. J. G. Murphy's "Habit and Intelligence," rightly—in our opinion—attribute to the lower animals the power of invention.

Mr. Dieckmann ("American Naturalist") states that tigers are plentiful throughout Siberia, where they remain through the

winter. They are said to be larger than the Himalayan specimens, and to have hair five inches in length.

Mr. W. B. Cooper ("American Naturalist,") raises the question, whether the human skull is becoming thinner?

The sparrow-plague in Australia and in America, suggests that the introduction of animal species into a country should no longer be left to the indiscretion of individuals.

Mr. C. V. Riley (American Association for the Advancement of Science, Cincinnati Meeting) argues from the appearance of noxious insects, that animals may, and in fact do, change their habits and diet suddenly.

Mr. J. J. Weir ("Entomologist") calls attention to the many cases in which the Lepidoptera of the Outer Hebrides differ from the normal colouration of their species, and assume the grey tone of the prevailing gneiss rocks.

Mr. F. J. O'Farrel, of Dublin, a pupil of Professor Galloway, has effected a great improvement in the isolation of glycerine from spent soap lyes.

It is reported that the vacant Chair of Natural History at Edinburgh will be conferred upon Prof. Ray Lankester.

Among the prizes proposed by the Academy of Sciences for 1883 is one for researches on the histological development of insects during their metamorphoses.

About the end of October last a very abundant shower of gossamer took place at Milwaukee.

The "Medical Press and Circular" gives an interesting account of the performances of the Howling Dervishes at Constantinople. The writer notes the connection of sensational religious displays with sexual excitement.

Professor Morris ("Science") strongly insists on the agnostic character of Mr. Herbert Spencer's extra-scientific philosophy.

M. Feye, of Detmold, finds that during three years the lightning struck annually 25·7 oaks, 4·7 beeches, 1·3 other large-leaved trees, and 11·3 conifers. It does not appear what were the relative proportions of the kinds of trees in question.

Prof. Naumann suggests, that the striæ in rocks generally attributed to glacier action may in some cases be due to the action of grains of sand and small pebbles driven by violent winds.

According to "Petermann's Geograph. Mittheilungen," the results of last year's arctic expeditions are disappointing. It is proved that the coast of Wrangel-Land will not form a good base for further progress northwards.

A. Woeikoff ("Zeitschrift für Erdkunde,") contends that general glaciation, from the Pole to about 45° lat., is not admissible. If there is sufficient sea it will not freeze, and in large continental surfaces the climate is too dry for glaciers.

The "Comptes Rendus" of last month announces the death of the illustrious French botanist G. Devaisne. The deceased entered the service of the Jardin des Plantes at the age of seventeen, as a working gardener. He died a Professor at the Museum, a member of the Academy of Sciences—of which he was at one time President—and a Fellow of the Royal Society.

M. Harting, of the University of Utrecht ("Comptes Rendus") made some years ago many "mesmeric" experiments upon fowls, pigeons, rabbits, frogs, &c. If the experiments were several times repeated upon the same animal its nervous system was much shaken. Six hens which had been thus treated were seized with hemiplegia and died successively. Hence, the Professor gives a caution as to mesmerising human subjects. (We suppose that in England, Prof. Harting would be amenable to the Anti-vivisection Act.

M. E. Renan shows that the term "anti-cyclone" is not justly applicable to such weather as has been lately experienced in Western Europe. One of these phenomena is not the other reversed: they belong to different orders.

M. Dareste has presented to the Academy of Sciences a memoir on the part played by the amnion in the production of monstrosities. His researches show that a great number of monstrosities result from the partial compression of the body of the embryo, the agent of such compression being the amnion arrested in its development. This compression only occasions teratological results when it is exerted early.

Mr. C. E. de Rance ("Geological Magazine") points out that the position of our ancient villages, and the directions in which our towns have extended, have been determined by the occurrence of springs.

Mr. C. E. Varley, the eminent physicist, has patented an improved divining rod for ascertaining the presence of metallic veins underground.

The "Lancet" says women are not fitted for the calling of Pharmaceutists, because "*they will* talk," and further, "there is in the mind of woman an inherent disability for work of any kind which requires concentration of thought and mental isolation. It is not that she will not, she *cannot*, attend to the business in hand so exclusively as it is necessary the practical pharmaceutist should attend, if his duties are to be discharged with credit to himself and safety to the customers."

Anti-vivisectionists deplore the existence of biologists who are not physicians as a modern innovation. A better acquaintance with the history of Science would show them that the early physicians had little to do with the development of biology, and that the early biologists did not much concern themselves with medicine.

Mr. W. E. Coleman ("Kansas Review of Science") shows that the true destroyer of the Alexandrian Library was not the Caliph Omar, but the fanatical Bishop Theophilus, A.D. 390.

Prof. Trowbridge ("Kansas City Review of Science"), in an able plea for museums of Natural History, curiously says "as the question of Evolution or of Creation is racking the whole scientific and religious world." Are the two mutually exclusive, unless we read "mechanical creation"?

It is generally supposed that all the Arabian philosophers were believers in alchemy. This, according to "Wiedemann's Annalen," is an error. Not only Ibn Khaldun, but At Kiudi and Avicenna and his school proclaim the transmutation of metals impossible, the philosopher's stone a chimera, and the study of alchemy hurtful.

During the discussion which followed the reading of a memoir by Prof. Fairchild (New York Academy of Sciences), on a peculiar coal-like transformation of peat, lately discovered at Scranton, it was mentioned that Dr. Elsberg had—by the combined agency of moisture, heat, and pressure—converted peat into coal.

According to Morselli suicide becomes increasingly common with the growing density of population. Since the beginning of the century it has increased more rapidly than population and than the general mortality. The cases in the United States are 35 per million; Ireland, 16; England, 67; Belgium, 55; Holland, 35; Hanover, 140; Prussian Saxony, 228; Gallicia, 98. Climate is not an important factor.

M. E. Blanchard has laid before the Academy of Sciences a memoir showing the existence, at a comparatively recent date, of a large Austral continent, of which New Zealand is the chief relic. He does not suppose that it was ever connected with Australia. At the conclusion of the paper M. Milne-Edwards thought it necessary to make some remarks quite foreign to the subject.

M. J. M. Charcot ("Comptes Rendus") recognises in "hypnotism" three distinct stages, *i.e.*, the cataleptic state, lethargy, and somnambulism.

ERRATA.—Page 109, line 19 from bottom, for "*etorigo*" read "*et origo.*"
Page 110, line 14 from bottom, for "Protogoras" read "Protagoras."